# REQUEST FOR PROPOSAL
## Specifications for Construction

**SOLICITATION NO. W9128F23R0012**

# B-21: WEAPONS LOADER TRAINING (WLT) FACILITY
# PNFXBM23180 (FY23)

# ELLSWORTH AFB, SOUTH DAKOTA

# MAY 2023

PREPARED BY:
U.S. Army Corps of Engineers, Omaha District

***BUILDING STRONG***

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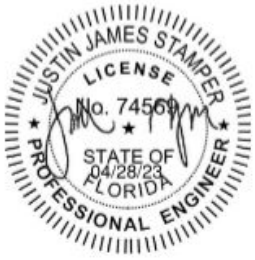
| | |  |
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**SPECIFICATIONS FOR CONSTRUCTION**
**OF**
**B-21 WEAPONS LOADER TRAINING (WLT) FACILITY**
**PNFXBM23180 (FY23)**
**ELLWORTH AFB, SOUTH DAKOTA**

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WORK RESTRICTIONS
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PART 1 GENERAL

Attachments: EAFB Entry Authority (EAL) Instructions.

1.1 REFERENCES

The design publications listed below shall be used as sources of criteria for the design. The most current edition of the code or standard (with errata and addenda) available at the RFP proposal submission deadline shall be used as criteria for the design - unless noted otherwise. The criteria from these sources may be supplemented, but not supplanted, by applicable criteria contained in nationally recognized codes and standards.

INTELLIGENCE COMMUNITY STANDARD (ICS)

| | |
|---|---|
| ICD/ICS 705 | Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities |
| ICS 705-1 | Physical and Technical Security Standard for Sensitive Compartmented Information Facilities |
| ICS 705-2 | Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information. |

U.S. AIR FORCE (USAF)

| | |
|---|---|
| AFI 31-101 | Integrated Defense |
| AFI 16-1404 | Air Force Information Security Program |
| AFI 16-1406 | Air Force Industrial Security Program |

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
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| DODM 5200.01 | DoD Information Security Program (Volumes 1-3) |
| DODM 5200.08 | (Volume 3) Physical Security Program: Access to DoD Installations |
| DODM 5205.07 | (Volume 3) DoD Special Access Program (SAP) Security Manual: Physical Security |
| UFC 4-010-05 | Sensitive Compartmented Information |

Facilities Planning, Design, and Construction, with Change 1, dated 1 October 2013

1.2 DEFINITIONS

See the design drawings and specifications for descriptions of major components of work under this project to include, but not limited to "Restricted Area," "Free Zone," etc.

1.2.1 Secure Area(s)

Areas identified in the design documents as "secure areas" shall be designed, constructed, and accredited to the criteria listed below. The contractor shall design and construct the perimeter and all spaces within the boundary in compliance with the following criteria:

The listed criteria carries impacts to all building systems within the designated boundary. Use the most current version of the referenced criteria available at the bid submission deadline:

a. ICD/ICS 705 - Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities.

//www.dni.gov/files/NCSC/documents/Regulations/IC_Technical_Specifications_for_Cor
b. ICS 705-1 - Physical and Technical Security Standards for Sensitive Compartmented Information Facilities.

c. ICS 705-2 - Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information.

d. UFC 4-010-05 - Sensitive Compartmented Information Facility Planning, Design and Construction.

e. DODM 5205.07 - DoD Special Access Program (SAP) Security Manual: Physical Security

The design drawings and specifications indicate the technical mitigations required by the project. This specification indicates the Contractor and Government's role(s) in administering the secure areas during construction for accreditation by assigned authorities.

1.2.2 Construction Secure Area Perimeter

A potentially moving boundary established during project construction by which the SSO and SSM assign layers of oversight for purposes of Construction Security Plan (CSP) implementation in compliance with ICD/ICS 705 and DODM 5205.07. This perimeter is established by a site perimeter fence (described below and in the design drawings) early in construction and prior to the construction of the physical, permanent secure area boundaries as defined in the facility floor plans. Once the permanent secure area boundaries are substantial enough to establish effective access control (as determined by the SSM), the boundary may be re-established by the SSM to isolate secure area construction and materials from non-secure area construction for more effective secure area oversight. Continuity of the secure area perimeter must be maintained by the Contractor (via a combination of temporary and/or permanent construction) for the entirety of contruction from CSP implementation through facility turnover. Coordinate the perimeter(s) and transtions from

one CSP implementation perimeter to another with the SSM and with the anticipated order of construction, through the duration of the project.

1.2.2.1 CSP and Secure Area Implementation

This project contains multiple secure areas within a combined facility perimeter. CSP implementation will occur on the entirety of this project within the parameters described below:

a. Secure area oversight and administration per secure area criteria referenced below will occur on (2) rooms totaling approximately 1,000 SF in the proposed facility. Each of the spaces will be bound by their own secure area boundary and asscіated entry vestibules. Exact room(s) to be identified to the awarded contractor after construction contract award. All other work under this project is not considered secure area work unless referenced otherwise.

b. The Government does not intend to establish a secure area perimeter and access control until the secure area boundary is roughly constructed and secureable on all sides. Once construction of those perimeters begins, initial secure boundaries will be established at the existing hangar boundary and may be reduced upon SSM approval as decribed in "Construction Secure Area Perimeter" paragraph above.

c. During construction, the Contractor shall continuously notify the Government when construction secure area perimeters and secure material storage areas are intented to be established and/or revised depending upon the nature of work being performed. This shall be discussed during established weekly meetings so that the Government may position personnel to carry out inspection and oversight of those activities, materials, and features of work. The Government reserves the right to segregate and compartmentalize materials from the established stock for installation and/or inspection as part of the secure area perimeter. All materials intended to be installed in a project secure area shall be stored within a fenced perimeter on the project site - unless approved otherwise, in writing, by the SSM. The Contractor shall provide a high security lock and keys by which to secure each perimeter at the end of each work day. The SSM shall be provided with sole keyed access to any secure material storage area(s) and the SSM reserves the right to track entry and egress from the storage area(s). Secure area material storage areas will be secured by the SSM after the end of each work day and re-opened by the SSM each day.

d. The Government will establish and man the access-controlled secure area and secure area material storage perimeter(s) - either at secureable building and/or room boundaries, or at contractor-provided fenced boundaries as indicated in the design drawings. The point at which access control is established may vary as each respective facility (and perimeter) is constructed and secured. The Government does not intend to dictate the specific time at which individual perimeters are established as long as the security of each facility is continually maintained as each facility is constructed. The Contractor shall notify the Government no less than (NLT) 30 Days in advance when they anticipate any features of work will be ready for access control to be established.

e. CSP implementation will only occur on the project onces the SSAMP is approved and the secure area and secure area material storage

perimeter(s) are constructed (by the Contractor) and secureable by the SSM. The contractor may perform work around and outside the secure area perimeter, but no construction that conceals a volume, void, or that transverses or penetrates the secure area perimeter/volume on the secure or unsecure side will be allowed without written approval by the Government. This would include ductwork, piping, conduit, and equipment that occurs within the secure perimeter walls, plenum, or within the secure space itself. These features may be routed to the perimeter of the secure area, but shall not penetrate that boundary until Government oversight is in place. CSP implementation will occur from that point through the entire duration of construction to include procurement and installation of any bid options.

f. Once the perimeter is coordinated and established, access to the space will be exclusively through the Government's access control procedures as defined herein. Any deviations from the procedures herein must be coordinated with USACE and the SSM in writing.

Contractor responsibilities associated with CSP implementation will only terminate upon full Government acceptance of all work on and within the secure area perimeter and upon the Contractor's departure from the project site - including procurement and installation of any bid options awarded under this contract. While it is the Contractor's responsiblity to establish the order of work within the constraints established within this Contract, no work on or within the 6-sided perimeter of the secure area shall occur without implementation of Government and Contractor responsibilities associated with the approved CSP - as described herein.

The Contractor shall document their intended order of work and required points of interface with CSP requirements in the Security and Site Access Management Plan as defined below - as well as reflect this requirement in the project schedule.

1.2.3 Controlled Area(s) (CA)

An area within an installation with special access restrictions and security constraints - not otherwise defined by AFI 31-101 or as an installation Restricted Area. Access requirements may exceed "typical" base access requriements. Both base and CA access requirements are defined herein. Controlled area perimeter and access constraints are defined herein. CAs may be permanent or temporary. All work within a defined CA must be escorted unless work is being performed within a Government-approved CAWP, defined herein. When the CAWP cannot be directly accessed from outside of the CA, contractor personnel must be escorted to and from the CAWP.

1.2.4 Controlled Area Work Perimeter(s) (CAWP)

An area defined in the project plans and specifications that will function similar to a Free Zone defined by AFI 31-101 and herein. A controlled area work perimeter will typically be accessed from outside of a Controlled Area, but will require will require establishment of a perimeter and maintenance of that perimeter as described herein. See the design drawings for further definition of extents, phasing, and requirements for this project.

1.2.5 Security and Site Access Management Plan (SSAMP)

A detailed plan that acknowledges, describes, and details all unique

access control, security, and phasing requirements in this Contract. Project-specific requirements for the SSAMP are described below.

1.2.6 US Persons

Individuals lawfully admitted for permanent residence as defined in U.S.C. § 1101(a)(20) or who is a protected individual as defined by Title 8 U.S.C. §1324b (a)(3)).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation 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

Project Security And Site Access Management Plan; G, RO

CUI Training; G, RO

1.4 PROJECT SECURITY AND SITE ACCESS MANAGEMENT PLAN (SSAMP)

This project contains a variety of work under various security, access, and oversight requirements/limitations. It is the Government's intent that the Contractor perform all work under the fewest constraints allowable under the applicable criteria, and as applicable to the individual component of work defined by the entirety of this RFP. This specification and the entirety of the design drawings and specifications communicate all applicable requirements, and the Contractor must provide a plan for compliance with these constraints that is consistent with their technical approach for construction.

NLT 30 days prior to anticipated on-site mobilization, the Contractor is to provide a Project Security and Site Access Management Plan (SSAMP) for approval by the Government. The SSAMP shall incorporate the constraints described below and throughout the Contract. This shall include, but is not limited to, the following information.

a.List of primary and secondary Contractor POCs for Project security and access management.

b. List of Contractors and Subcontractors requiring site access.

c. Anticipated secure area and secure area material storage perimeter(s) with specs, dates, and durations. Indicate any anticipated changes to the perimeters(s) during the duration of the project.

d. Anticipated construction perimeter(s) (fence(s) and/or room(s)) with specs, dates, and durations. Indicate any anticipated changes to the perimeters(s) during the duration of the project. Communicate a plan for continuity of secure area and secure area material storage perimeter(s) for the entirety of construction.

e. Anticipated dates and durations of various work activities that will require Government oversight and/or escorts per the requirements in this Contract.

f. Description of Contractor processes and procedures associated with Secure Area construction, oversight, accreditation, and associated security requirements.

g. Anticipated procedures for Contractor site security and access management for each work activity.

h. Anticipated usage of temporary and/or permanent doors (with locks), barriers and similar at secure area perimeters, etc.

j. List of anticipated closures/outages, etc that may impact Government oversight, or work outside of normal hours as listed in 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

k. CONTROLLED UNCLASSIFIED INFORMATION (CUI)document storage and handling procedures.

l. Procedures for advising Subcontractors and delivery activities on the location of the project site and appropriate POCs (primary and secondary) for Security Forces to verify project deliveries against.

m. Describe the technical approach to design and construction of the facility(ies). Include considerations for management of both the "Secure Area" construction security (in accordance with UFC 4-010-05, ICD/ICS 705, DODM 5205.07, AFI 31-101, AFI 16-1404, AFI 16-1406, and DODM 5200.01.

n. Processes and procedures (as applicable) for isolating construction under "finishing phase" from other construction for implementation of "US Citizen Requirement During Finishing Phase" paragraph described herein.

The SSAMP must be treated as a living document that records the Contractor's approach for compliance with work restrictions documented herein. As Contractor requirements and activities evolve, update the SSAMP for use, evaluation, approval, and reference by the Government. Coordinate SSAMP updates with overarching construction schedule and "lookahead" activities defined in 01 32 01.00 10 PROJECT SCHEDULE.

## 1.5 ORDER OF WORK RESTRICTIONS

The order in which work is performed shall conform to the following constraints:

a. See the design drawings and other specifications for project-specific order of work and phasing restrictions. This may include, but is not limited to phasing constraints relating to AGE Fuel island flightline access, separation of the proposed work area within the facility from other work areas under separate contract, placement and relocation of utilities, construction and removal/relocation of the construction controlled area/CAWP perimeter.

b. This project is one of several that serve as part of the B-21 facilities beddown at Ellsworth AFB, SD. The contractor shall continually coordinate work with other construction activities that serve as part of the EAFB B-21 Beddown. See 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS for contractor coordination meeting participation requirements.

c. The EAFB Flightline Controlled Area (CA), and associated flightline activities will remain in operation during the entire construction period. The Contractor must conduct their operations so as to cause the least possible interference with normal operations of RA/CA activities. See the design drawings for additional accomodations and requirements.

d. This project sits adjacent to an established Restricted Area and partially within the flightine Controlled Area. While significant work inside the RA is not anticiapted under this project, any work within EAFB Flightline RA or CA at any time during construction shall also be escorted with Contractor-provided escorts per the RA escort requirements and/or conducted within an approved free zone/CAWP described herein.

e. Permission to interrupt any roads, railroads, or utility service must be requested in accordance with requirements listed in 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

f. Permission to establish new free work zones/CAWPs, as well as Government escorts and oversight shall be coordinated in compliance with the requirements listed below.

g. Any utility outages associated with the project shall be planned well in advance. Contractor shall notify the Government of any required outages that may impact any RA facilities in compliance with utility outage request requirements in 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

h. Work shall be completed in a manner that reduces requirements for security oversight when possible.

j. The Contractor is responsible for any labor and materials required to construct and/or perform the entirety of the work sited and/or occuring within the RA/CA at Ellsworth AFB. Work within the the Ellsworth AFB RA or CA, but outside of an approved free zone/CAWP requires escorts or Cleared American Guard (CAG) oversight as defined herein. When the free zone/CAWP cannot be directly accessed from outside of the RA/CA, contractor personnel must be escorted to and from the free zone/CAWP. Work required to establish or remove free zone/CAWP perimeter(s) also requires escorts and/or CAG oversight as defined herein. Finally, work inside and on the existing RA perimeter fence serving the Ellsworth AFB RA requires escorts or CAG oversight as defined herein. The Contractor is required to obtain RA escort badging and/or employing the services of escorts (CAGs) as to fully execute the work within the constraints defined herein.

k. Coordination of the use of controlled area/CAWP oversight shall occur in compliance with the requirements listed below.

l. The Contractor is responsible for all labor, costs, and materials required to construct the entirety of the work described in this contract.

1.5.1 Desire for Innovation

The Government is looking for ways to streamline construction and manage labor and other resource constraints in an effort to mutually reduce costs

and achieve an aggressive schedule while minimizing impact to the Base and Base operations. The Contractor should consider these constraints when developing the project schedule and work activities, and should propose innovative and/or alternative solutions for Government consideration. Any non-standard solutions require Government review and formal acceptance prior to implementation.

## 1.6 DOCUMENT CONTROL

All contract documents (including the design analysis, plans, and specifications) shall be treated as For Official Use Only (FOUO) or Controlled Unclassified Information (CUI) by the Contractor - regardless of labeling on the reference documents. The Contractor shall track and control access to the contract documents in compliance with AFI 16-1404 and DODM 5200.01. The Contractor shall log personnel and entities that have access to documents and hardcopies. Those logs shall be available to the Government for review and should include the entity and responsible party to which documents were issued.

Distributed hardcopies of documents shall be stored within the controlled area perimeter or locked in the contractor's construction office when not in use and during non-work hours. Plans shall be returned to the Contractor as entities complete their work activities. Contractor shall destroy all hardcopy documents not turned over to the Government upon project completion.

### 1.6.1 CUI Training

In accordance with DoDI 5200.48 "Controlled Unclassified Information", all personnel handling CUI must comply with initial and annual refresher CUI training requirements by taking the course "DoD Mandatory Controlled Unclassified Information (CUI) Training" at https://securityawareness.usalearning.gov/cui/index.html and print or save a copy of certificate for each individual with access to CUI in performance of the contract and maintain documentation of this training.

## 1.7 BASE ACCESS AND SECURITY

### 1.7.1 General

The US Army Corps of Engineers (USACE) (in collaboration with Base Civil Engineering Squadron) will coordinate installation and controlled area entry with resource managers on Ellsworth Air Force Base (EAFB). Base Security Forces Squadron (SFS), will assist the Contractor with initiating security reviews (e.g. local and national agency checks) and requesting access and/or badges as described below. The Contractor shall furnish a list of Contractor personnel requiring entry to EAFB and the controlled area. This list will be provided as soon as possible, but not later than ten (10) days, after contract award and maintained current as Contractor personnel are added or dismissed from the contract/project.

After initial acceptance of the list, submit changes and updates a minimum of 10 working days prior to the date of required access.

### 1.7.2 Base Hours

The commercial gate to EAFB is open from 0600-1800 Monday-Friday and 0600-1300 on Saturdays except when directed by the base commander under conditions of National Security. Work outside those hours shall be

coordinated with USACE and Security Forces Squadron per the requirements of this specification and 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

1.7.3 Scheduled and Unscheduled No Work Days

See 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS, for requirements relating to weather delays and federal holidays. Official snow call or late reporting may affect the Contractor's production for which the KO will not consider reimbursement for lost work time.

In addition to weather delay days and other scheduled no work days, the Contractor shall accommodate not less than 25 mission delay days as unscheduled no work days in the project schedule.

These days will be invoked by the Government for exercises, events, operations, and other mission-specific events that inhibit or prohibit the Contractor's ability to work on the project site and/or controlled area.

1.7.3.1 Operational Delays

The Contractor and their personnel shall leave Ellsworth Air Force Base (EAFB) immediately and safely upon notification by the Contracting Officer (CO), his technical representative, or constituted authority when directed, that operational requirements or emergencies dictate. Normal delay should not exceed one hour in duration.

1.7.3.2 Right to Deny Entry onto Base

The Installation Commander or designated representative reserves the right to deny entry to any Contractor whose National Agency Check is unfavorable, and the right to terminate the entry authorization of any Contractor employee upon disclosure of information which indicates the individual's continued entry to EAFB is not in the best interest of national security. Additionally, the violation of or any deviation from established security procedures by the Contractor's employee may result in the confiscation of badges and the denial of future entry to EAFB.

1.7.4 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 hard hats 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.

1.7.4.1 Subcontractors and Personnel Contacts

Provide a contact list of personnel for 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.

1.7.4.2 Identification Badges and Installation Access

a. Each Contractor employee to work on the project at Ellsworth AFB must obtain a base pass to enter the base. The pass must be obtained prior to entry on EAFB. To obtain the base pass, personnel must have in

their possession, a current, valid driver's license and if driving a vehicle onto base a current vehicle registration, and current proof of insurance. Procedures for obtaining a base pass will be identified at the Pre-Construction Meeting. Expired/unregistered vehicles will not be allowed on base.

Employees who are terminated from employment will surrender any and all identification media and base passes to their immediate supervisor, who will in turn surrender same to the EAFB Pass and ID Office, and the supervisor will immediately escort the terminated employee off base, and notify SFS of the termination.

Access to EAFB shall be through the commercial gate (Bismark Gate) Gate indicated in the design drawings. The Contractor shall provide USACE and SFS a copy of a completed "Entry Authority List (EAL)", which is to include the names of all subcontractors and suppliers, and the names and driver's license numbers of all employees requiring access to the Base.

The commercial gate to EAFB is open from 0600-1800 Monday-Friday and 0600-1300 on Saturdays except when directed by the base commander under conditions of National Security. All commercial vehicles shall use the right lane of the gate - or as directed by SFS personnel. A commercial vehicle is defined as any vehicle that has signage on it, is carrying materials such as in a pickup truck, a moving van, a panel truck, a supply truck, and any vehicle that the SFS shall designate a commercial vehicle. All commercial vehicles will be searched. The gate experiences up to 60 minute delays during morning congestion between the hours of 0630 to 0800. After 0800, delays of approximately 5-30 minutes are typical. The contractor is asked to keep large truck deliveries between the following hours: 0600-0700, 0800-1200 and 1300-1800. This will reduce the congestion at the gate for everyone.

b. All drivers on EAFB will have in their possession a valid driver's license, valid vehicle registration, and proof of vehicle insurance while operating any vehicle. If vehicle is registered to someone other than the operator, the operator must provide a notarized letter from the registered owner, authorizing the operator permission to operate the vehicle. Access by vehicles to the Base and project site is at the sole discretion of the Government. Security process and procedures at the Base change over time. Coordinate specific access details with the Government after contract award.

   The company name shall be prominently displayed on all vehicles operated on EAFB.

c. The Contractor's Superintendent must notify SFS through the Contracting Office prior to any work to be performed on non-scheduled hours/days (evenings, weekends, holidays). Any personnel working on non-scheduled hours/days must check in with SFS, prior to and at the completion of the work.

d. All equipment and materials are the responsibility of the Contractor. Make sure that all equipment and materials are properly secured at the end of the work day. Assure that materials and equipment are stored at least 30 feet away from any restricted area perimeter fence, unless approved. Any work area found by Base Security Forces to be unsecured (or improperly secured) will be checked for intruders and the responsible Contract Superintendent will be called in to secure the

areas/equipment.

e. If any roadway is to be blocked for any reason, the Contractor must notify, through the Contracting Office, the Base Security Forces of the blockage, prior to the blockage, and must ensure that proper signs are provided by the contractor and installed to divert traffic around the affected area. Notifications for closure and/or blockages less than 1 week in duration shall be submitted to USACE for coordination no later than 14 days prior to required outage. As much lead time notification as possible is appreciated for proper coordination, and notification of other activities on base. Any outages for more than 1 week in duration shall be submitted no less than 28 days in advance.

f. Contractors, Subcontractors and all personnel who report for work, and do not know the location of the job site, will be held at the entry gate to await escort service from the Construction Superintendent.

g. Base speed limits are strictly enforced with the use of radar equipment. The base speed limit is 25 MPH, unless otherwise posted. Motorcycle operator/riders must wear protective headgear (helmets) while riding on base. Mandatory seatbelt laws are in effect on base. Seatbelts must be fastened prior to entering the base. Cell phones may not be used while driving on any Air Force Base, including EAFB.

h. Normal contractor access to the Base will be as indicated in the design drawings. See requirements above regarding scheduled and unscheduled no work days, as well as weather and federal holidays listed in Section 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS. Access on dates when the assigned contractor access gate is closed will be coordinated with the Contracting Officer. Deliveries cannot be accepted on these dates unless requested in writing from the Contracting Officer and access will be granted only under extenuating circumstances.

j. The base security police can at any time enter the construction site and sweep the area with K-9 Patrol. They can search any container, vehicle, or contractor personnel on the installation, or within the construction boundaries. The security police can also detain and question any person(s) deemed a potential threat by the Air Force.

k. The Base Security Forces emergency number can be obtained at the Pre-Construction Meeting. This number provides emergency police, fire, and ambulance service, 24 hours a day, 7 days/week.

l. No privately owned weapons or contraband (drugs, etc.) are permitted on any military installation, at any time. Violators will be prosecuted through the Federal Magistrates Court in Denver. Cameras are also considered to be contraband on this installation.

m. The Contractor shall provide a 24-hour, 7-day-a-week contact number to SFS in case of suspicious activity at the construction site or if the site is found unsecure. If required by SFS, the contractor will have someone respond to the construction site within 4 hours.

n. Ellsworth AFB is considered to be a closed facility. No unauthorized tours or visitors will be allowed on the installation.

1.7.4.3 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.

1.8 RESTRICTED AREA (RA) AND CONTROLLED AREA (CA) ACCESS AND SECURITY

EAFB is a closed base. Within the installation boundary there is a permanent Restricted Area (RA) around the flighline area as well as a separate flightline Controlled Area (CA). Restricted Areas, by definition, contain priority resources and are established pursuant to DODM 5200.08, Security of DoD Installations and Resources. Because priority resources are contained within the restricted area, a single security system and circulation controls are required and employed.

Access into these areas is separately managed from the EAFB installation iteslf. Access is highly controlled and construction activities associated by this contract shall be coordinated with existing RA/CA access control and security procedures.

The process and procedures to enter the EAFB RA/CA are different than the general requirements to enter the installation boundary. As referenced, the US Army Corps of Engineers (in collaboration with Base Civil Engineering Squadron) will coordinate restricted area entry with the resource managers of the areas on EAFB and with the Base Security Forces Squadron (SFS).

1.8.1 Right to Deny Entry into Restricted Area/Controlled Area

The Installation Commander or designated representative reserves the right to deny entry to any Contractor whose NAC is unfavorable, and the right to terminate the entry authorization of any Contractor employee upon disclosure of information which indicates the individual's continued entry to EAFB and the RA/CA is not in the best interest of national security. Additionally, the violation of or any deviation from established security procedures by the Contractor's employee may result in the confiscation of restricted area badge and the denial of future entry to EAFB.

1.8.2 RA Badging

A Restricted Area Badge for Escorted Entry only (Escort Required, i.e. not requiring or authorized access to classified information) may be issued to Contractor personnel meeting the following qualifications:

a. Subject will be employed for six or more months.

b. Contract is for more than six months.

c. Subject has completed a National Agency Check (NAC).

d. Subject has received a favorable local agency/files check initiated by SFS. **NOTE:** Badges authorized under the aforementioned provisions are only for the flightline Restricted Area on EAFB. No other areas, restricted or controlled, will be entered on the badge. Badges will not be electronically coded for any module or controlled by the Advance Entry

Control System (AECS). The Governmnet may issue RA badges to Contractor personnel, but escort authority is not granted to Contractor personnel unless specifically indicated on the RA badge. See "Contractor-Provided Escorts" paragraph below. If any other areas are required, the badge will be issued only upon completion of appropriate background investigations.

e. Security Forces personnel will verify the identity and authorization of each Contractor employee requesting entry to the installation or restricted area, and may conduct searches of any hand-carried item, container, or vehicle used by the Contractor under this contract.

f. The contractor shall absorb all costs associated with delays at the installation entry points, restricted area entry points, or any other locations affected by security entry/circulation control measures. Assume the RA badging process may take up to 30 days upon Government receipt of documentation from the contractor (including CAGs or Contractor-Provided Escorts as described below).

g. Complete any Air Force required training for safe and secure movement and operations within the restricted area. This includes, but is not limited to airfield drivers training, AT/OPSEC training, etc.

1.8.3 CA Badging

A flightlne Controlled Area Badge for Escorted Entry only (Escort Required, i.e. not requiring or authorized access to classified information) may be issued to Contractor personnel meeting the following qualifications:

a. Subject will be employed for six or more months.

b. Contract is for more than six months.

c. Subject has initiated a National Agency Check (NAC).

d. Subject has received a favorable local agency/files check initiated by SFS. **NOTE:** Badges authorized under the aforementioned provisions are only for the flightline Controlled Area on EAFB. No other areas, restricted or controlled, will be entered on the badge. Badges will not be electronically coded for any module or controlled by the Advance Entry Control System (AECS). The Governmnet may issue CA badges to Contractor personnel, but escort authority is not granted to Contractor personnel unless specifically indicated on the badge. See "Contractor-Provided Escorts" paragraph below. If any other areas are required, the badge will be issued only upon completion of appropriate background investigations.

e. Security Forces personnel will verify the identity and authorization of each Contractor employee requesting entry to the installation or restricted area, and may conduct searches of any hand-carried item, container, or vehicle used by the Contractor under this contract.

f. The contractor shall absorb all costs associated with delays at the installation entry points, restricted area entry points, or any other locations affected by security entry/circulation control measures.

g. Complete any Air Force required training for safe and secure movement and operations within the restricted area. This includes, but is not limited to airfield drivers training, AT/OPSEC training, etc.

1.8.4 Contractor-Provided Escorts

The Contractor shall provide RA/CA escorts (as part of the contract base bid) and/or CAGs as required to fully execute the scope of work defined by this contract in compliance with the security requirements established herein and in the approved SSAMP. This may be accomplished by self-escorting personnel, employing Cleared American Guards (CAGs), and/or a combination of both - as indicated in the approved SSAMP.

Any costs for escorting associated with the procurement, construction and/or installation of bid options, to include relocation of shelving from Dock 63, shall be included within each respective bid option price.

The contractor shall provide escorts under the following constraints:

a. Work within an approved free zone perimeter/CAWP does not require Contractor-provided escorts.

b. Work within the the EAFB RA/CA, but outside of an approved free zone/CAWP (including access to a free zone/CAWP that cannot be accessed from outside the RA/CA requires Contractor-provided escorts or Cleared American Guard (CAG) oversight as defined herein.

c. Work required to establish and/or remove free zone perimeter(s)/CAWP(s) also requires Contractor-provided escorts or CAG oversight as defined herein.

d. Finally, work on or within the RA/CA perimeter fence serving the EAFB RA/CA requires Contractor-provided escorts or CAG oversight as defined herein.

The Contractor is required to obtain RA/CA escort badging and/or employing the services of escorts (CAGs) as to fully execute the work within the constraints defined herein.

1.8.4.1 Escort Ratios

Contractor-provided escorts and CAGs shall comply with the most-stringent of the following on each work activity:

a. Escorts/CAGs shall not oversee more than 10 escortees for every single (1) escort or guard (maximum 10:1 ratio).

b. Contractor-provided escorts/CAGs shall have direct line-of-sight to all assigned escortees at all times. The means that certain work activities may require more escorts than the maximum ratio allows.

The Contractor shall clearly communicate their anticipated plan for Contractor-provided escorts/CAGs in relation to work activities in the SSAMP.

1.8.4.2 Self-Escort Badging

The Contractor may assume that the Government will issue up to (2) "escort authorized" badges to the Contractor during the duration of construction under the terms described herein. Each requesting applicant must have a completed National Agency Check (NAC) with 'Tier 1' status. Escorts must also comply with the badging requirements indicated above, attend any required RA escort training, and shall return their "escort authorized"

badge upon completion of activities that necessitate the escort privilege. USACE will sponsor NACs for the (2) referenced personnel. Background check times vary, but may take up to 90 days. The contractor is responsible to complete all required forms, fingerprints, and background information as required for the NAC. Blank forms will be provided upon request. USACE will not be held responsible for schedule delays associated with personnel that do not pass the NAC and are unable to be cleared for badging/escort privelages.

1.8.4.3 Cleared American Guards (CAGs)

As an alternative, the Contractor may employ the services of CAGs in order to address escort requirements on the project. CAGs shall meet the following requirements:

a. CAGs must possess an active SECRET security clearance as verified by JPAS and must be an American citizen. SECRET clearance must be maintained throughout the entire contract performance period.

b. CAGs employed by the CONTRACTOR to perform work under this CONTRACT shall be able to communicate effectively in both written and oral English.

c. CAGs must be active and fit enough to conduct their role on an active construction site. They must provide their own Personal Protective Equipment (PPE) and training appropriate for themselves, in compliance with EM 385-1-1.

d. CAGs must wear uniforms at all times. These uniforms must clearly identify the name of the contractor and the name of the individual performing under this contract. This identification may be accomplished through the use of shoulder patches, silk screening or stitched company emblems, insignias, or logos.

1.9 FREE ZONE ACCESS AND SECURITY (AS REQUIRED)

When properly utilized, free zones minimize the oversight and operational risk to both the Government and Contractor. When employed on the project, free zones shall comply with the following:

a. The contractor is responsible for erecting free zone perimeters to SFS requirements as defined herein. Provide free zones where indicated in the design drawings. Additional free zones may be requested per the procedures listed below.

b. Each free zone shall have a continuous boundary, constructed to the requirements in the design drawings, with a single point of entry (a gate).

c. Each free zone gate shall be manned by a Contractor-provided security specialist (a NAST or Contractor employee) at all times when the worksite is open.

d. The Contractor, shall track and record free zone entry and exit at all times. All personnel entering the site will be validated by scanning their issued construction site badge or reviewing their identification to the approved access roster of authorized construction personnel. Personnel in possession of personal electronic devices such as cameras, laptops, etc, will have these devices and their serial

numbers checked against the approved list to assure no unauthorized devices enter the construction sites. Additionally, log exit of site workers and personnel via badge scanning or access roster logging.

e. Control access of personnel, equipment, and vehicles to the free zone. Coordinate procedures with SFS and the project SSM.

f. Open and close the free zone site in coordination with Base Security Forces procedures. Coordinate clearing, closure, and turnover of access control operations (during non-work hours) with Base Security Forces.

g. The contractor shall provide temporary free zone entry point and boundary lighting for any work that occurs within a free zone outside of daylight hours. Coordinate temporary lighting needs with the anticipated order of work and construction schedule. Include plans for temporary free zone lighting in the SSAMP. Each Free Zone shall be lit during after-dusk working hours to a minimum of at least 0.2 fc at 6 inch above ground and an average of at least 0.5 fc at 6 inch above ground working plane. Lighting levels shall be retained not less than 30 feet on each side of the free zone boundary fence. This condition must be met by providing temporary lighting, no permanent lighting shall be installed. Temporary lighting is not required during non-work hours when free zone oversight has been relinquished to SFS.

## 1.10 CONTROLLED AREA WORK PERIMETER (CAWP) ACCESS AND SECURITY

When properly utilized, CAWPs minimize the oversight and operational risk to both the Government and Contractor when working within or around installation controlled perimeters. When employed on the project, CAWPs shall comply with the following:

a. The contractor is responsible for erecting CAWPs to SFS requirements as defined herein. Provide CAWPs where indicated in the design drawings. Additional CAWPs may be requested per the procedures listed below.

b. Each CAWP shall have a continuous boundary, constructed to the requirements in the design drawings, with a single point of entry (a gate) from outside of the controlled area that is being protected. CAWP access shall not be from within an established CA.

c. Each CAWP gate shall be manned by a Contractor-provided security specialist (a NAST or Contractor employee) at all times when the worksite is open.

d. The Contractor, shall track and record CAWP entry and exit at all times. All personnel entering the site will be validated by scanning their issued construction site badge or reviewing their identification to the approved access roster of authorized construction personnel. Personnel in possession of personal electronic devices such as cameras, laptops, etc, will have these devices and their serial numbers checked against the approved list to assure no unauthorized devices enter the construction sites. Additionally, log exit of site workers and personnel via badge scanning or access roster logging.

e. Control access of personnel, equipment, and vehicles to the CAWP. Coordinate CA and permanent flightline access procedures with SFS and the project SSM.

f. Open and close the controlled area in coordination with Base Security Forces procedures. Coordinate clearing, closure, and turnover of access control operations (during non-work hours) with Base Security Forces.

g. The contractor shall provide temporary CAWP entry point and boundary lighting for any work that occurs within a CAWP outside of daylight hours. Coordinate temporary lighting needs with the anticipated order of work and construction schedule. Include plans for temporary CAWP lighting in the SSAMP. Each controlled area shall be lit during after-dusk working hours to a minimum of at least 0.2 fc at 6 inch above ground and an average of at least 0.5 fc at 6 inch above ground working plane. Lighting levels shall be retained not less than 30 feet on each side of the CAWP perimeter fence. This condition must be met by providing temporary lighting, no permanent lighting shall be installed. Temporary lighting is not required during non-work hours when CAWP oversight has been relinquished to SFS.

## 1.11 SECURE AREA OVERSIGHT

Oversight and administration of the secure area per ICD/ICS 705 and DODM 5205.07 is a Government-led function. This is managed on-site through the Government-assigned site security manager (SSM), who works through the Government-assigned site security officer (SSO) to document and report project compliance with ICD/ICS 705 to the appropriate accrediting official (AO) and/or accrediting agency. Typically, these requirements are documented in the project Construction Security Plan (CSP). The Contractor shall assume that they will only be provided with access to portions of the CSP documentation that relate to their role in the project, listed below.

Comply with SSM direction for compliance with the CSP at all times. In the event of a conflict between SSM direction for CSP compliance and the requirements of this Contract, immediately seek resolution from the Contracting Officer.

### 1.11.1 Secure Area Access Control and Surveillance/Oversight

Secure area access control and surveillance oversight will occur on this project in order to assure CSP compliance through the entirety of the CSP implementation period as defined herein. Secure area access control and oversight will be conducted by Government personnel and/or via separately contracted services.

Access control is provided by manning a single door/gate at each construction secure area perimeter(s) and verifying whether access is authorized via both a Government-managed badging/marking system and access roster. Access control is accomplished by Non-cleared American Surveillance Technicians (NASTs).

Oversight is accomplished by providing line-of-sight surveillance of construction activities in secure areas to assure compliance with ICD/ICS 705, DODM 5205.07, and the approved project CSP. Construction surveillance of Secure Areas is accomplished by Cleared American Surveillance Technicians (CASTs).

The SSM may employ a staff of personnel in order to perform access control and oversight functions. Continuously coordinate the order of construction work with access control and oversight procedures (as defined herein) in

order to assure the least potential for conflict between construction activities and CSP implementation for a complete and accreditable secure facility.

1.12 PROJECT "SECURE AREA" ACCESS AND SECURITY

The process and procedures to enter the project secure area may be different than the general requirements to enter EAFB. The Contractor shall include provisions in their SSAMP that address and acknowledge the time, security, and oversight constraints associated with constructing new facilities in compliance with ICD/ICS 705, in coordination with the CSP and secure area implementation constraints referenced above.

All personnel entering project the secure area(s) and/or secure area material storage perimeter(s) after established and secured per the requirements herein must be US Citizens or US Persons. Some components of work may require US Citizen status. Any such requirements will be identified in the respective technical specifications for that work. Also see bid option for "US Citizen Requirement During Finishing Phase" below.

When properly utilized, the construction secure area perimeter will minimize the oversight and operational risk to both the Government and Contractor - while constructing, storing secure area materials, and administering a facility in compliance with ICD/ICS 705 and DODM 5205.07. Access to this perimeter will operate similarly to a "free zone," defined by AFI 31-101. The secure area perimeter must comply with the following:

a. Provide secure area perimeter fence(s) where indicated in the design drawings. The construction secure area perimeter fence(s) shall be in place and secured prior to any construction work being conducted within each facility footprint or facility construction materials are stored/placed on site. Additional fence(s) and perimeter(s) may be utilized. Any fence movements required during the duration of the project must be included in the SSAMP and be approved by the SSM/SFS.

b. Secure area perimeter(s) must have a continuous boundary, constructed to the requirements in the design drawings, with a single, securable access-controlled point of entry (a door or gate).

c. The access controlled point of entry shall be manned by a security specialist (NAST or Government equivalent) at all times when the worksite is open.

d. Provide a secureable temporary guard station (under the project base bid) at the primary entrance into the project site to accomodate sitting space for not less than two Government personnel. Provide temporary power and comm (NIPR) infrastructure to the guard shack in order to provide for basic lights, power, heating/AC, telephone (NIPR), and internet connection (NIPR). Guard shack and associated services shall be provided for the full duration of CSP implementation as described herein.

e. Provide temporary pathways (to include junction boxes, fittings, and pull string) and tempoary construction power in order to support installation of a Government-provided, Government-installed, wired closed-circuit television (CCTV) system to supplement oversight during the construction. Temporary installation shall comply with EM 385-1-1. Assume pathways are required for not less than 2 wired CCTV cameras to be installed throughtout the footprint of the secure area to provide

coverage of the secure perimeters described above. Precise locations to be coordinated with the SSM after construction contract award. CCTV pathways will be installed on structural steel or other supporting members as the facility superstructure is erected. Provide temporary construction power (120V/15A duplex receptacle) at each location where CCTV cameras are to be mounted. Pathways shall be rigidly mounted and routed within the secure perimeter in a manner that minimizes impacts to construction activities (such as routed on the secure side of the temporary secure area perimeter fencing). Pathway material must be continuous, fully enclosed, and provide for visual evidence of breakage/tampering. Pathways may be appropriate PVC material. Protective distribution systems (PDS) are not required. Pathways may be routed above grade out of the way of construction activities and/or temporarily buried. Pathway must extend from point of installation back to guard shack described above. Temporary pathways will be removed from the project site at the end of construction, at the direction of the SSM.

f. The security specialist must track and record secure area entry and exit at all times. All personnel entering the perimeter will be validated by scanning their Government-issued construction site badge/marking or reviewing their identification to the approved access roster of authorized construction personnel. Personnel in possession of personal electronic devices such as cameras, laptops, etc, will have these devices and their serial numbers checked against the approved list to assure no unauthorized devices enter the construction sites. Additionally, log exit of site workers and personnel via badge scanning, marking verification, and/or access roster logging - precise procedures to be coordinated after construction contract award.

g. Control access of personnel, materials, and equipment into the construction secure area perimeter. Coordinate secure area procedures with the project SSM.

h. Open and close access to the secure areain coordination with SSM and SFS procedures. Coordinate clearing, closure, and turnover of access control operations (during non-work hours) with the SSM.

j. Provide a high-security lock for the secure area perimeter door/gate, keyed for fire and SFS access.

1.12.1 US Citizen Requirement During Finishing Phase of Construction

This contract limits secure area access to approved US Citizens (in lieu of US Citizens or US Persons) in spaces begin finishing work through facility acceptance and turnover to the Government.

Spaces within the secure area perimeter will be limited to US Citizens only during finishing phases of the project. Once in "finishing phase" no US Persons (as defined herein) will be allowed anywhere in finished area(s) of the facility (or portion thereof) for the remainder of construction without the approval of the SSM in writing, and without escorts as prescribed by the SSM.

Finishing phases, for implementation of this requirement, is defined as construction after the facility secure area perimeter(s) (or portions thereof) are roughly constructed and/or the contractor identifies a need to start work that permanently conceals volumes and voids within the secure area perimeter(s) and/or volume(s). This would include installation

of any sheathing or finish products on the secure side (typically interior) of stud framed walls, any interior finish work, ductwork, installation of HVAC equipment, conduit, piping, and installation of fixtures and/or equipment that occurs within the secure perimeter walls, secure area plenum, and/or within the secure area volume itself.

The Contractor may isolate areas of the project in "finishing phase" from other areas of construction in order to maximize utilization of labor on the project site. If done, present a plan for accomplishing this for Government approval in the SSAMP. Finished areas must be clearly isolated or delineated (via a combination of temporary and/or permanent construction) from non-finished areas so that the SSM and associated staff may be able to identify and verify (via Government-issued badge, sticker, etc.) appropriate construction personnel are working in appropriate areas.

The Contractor may utilize US Citizens or US Persons for any work not otherwise limited to US Citizens elsewhere in this RFP and for any work outside the facility secure area perimeter(s) as described above.

## 1.13 ACCESS AND SECURITY ROLES AND RESPONSIBILITIES

### 1.13.1 Access to Construction Site

Once the perimeter construction fence is constructed per the requirements of this contract, it shall be inspected and approved by SFS. Once approved, the site is considered outside the Restricted Area and access may be managed by the contruction contractor as if it is no longer part of the EAFB Restricted Area. Restricted Area, Free Zone, and Secure Area requirements will only apply where those more restrictive conditions occur on the project.

### 1.13.2 Access Within Construction Secure Area Perimeter

This project requires design, construction, and accreditation of a Secure Area as defined by ICD/ICS 705, DODM 5205.07, and the design drawings and specifications. As such, Contractor shall ensure the facility is designed, constructed, inspected, and accredited in full compliance with the referenced criteria, and as directed by the project Construction Security Plan (CSP) and the Site Security Manager (SSM). Government and Contractor responsibilities for the duration of this project are listed below. Close coordination of these responsibilities is required and will require continuous coordination and fine-tuning through the duration of the Project.

#### 1.13.2.1 Contractor Responsibilities

a. Inventory, track, and store secure area construction-related plans and documents. When not stored within an approved project free zone (or equivalent), secure in a locable construction trailer or equivalent on the project site.

b. Erect a secureable perimeter around the entire Secure Area with a single securable access point and guard shack. Install CCTV pathways in coordination with the SSM.

c. Contractor will conduct initial vetting for workers using e-Verify to confirm all workers are US Citizens or US Persons and present a roster of all workers to the Site Security Manager (SSM, Government) who will verify using birth certificate, passport, or I-9 approved

identification. Any additional workers added after the initial roster is submitted will not be allowed access until proper vetting has been completed, which may take up to 30 days.

d. After successful validation of US Citizen or US Person status, the validated construction workers will be added to the access control roster, issued an access badge/marking and receive a security briefing from the SSM. The security badge/marking shall be in the possession of the worker while on site and shall be required for access to any secure or controlled area.

e. All construction workers performing work within the Secure Area will assure that they and their work are overseen at all times by security technicians - unless specifically waived by the SSM.

f. Workers will enter the site through the controlled access point only and must be on the controlled access roster provided to the onsite security specialist.

g. All construction equipment entering the perimeter will be validated through the security specialist and the SSM.

h. If the contractor has to perform work outside normal working hours, they shall coordinate the requirement as prescribed in 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

j. The Contractor shall maintain a clean and organized construction site. Store/park equipment and materials within the project site as directed by the SSM, in compliance with secure area and CSP requirements. Do not store equipment in a manner that would interfere with visual inspection of the secure area perimeter fence(s), unless specifically authorized in writing by the SSM and SFS.

k. Materials required for secure area construction will be procured through random selection from conventional sources. The contractor will obtain standard construction materials for the overall construction of the building and after SSM inspection upon arrival they will either be stored inside the construction secure area perimeter(s), SSM-controlled (but Contractor-provided) secure material storage areas, or within the secure area itself.

l. In the event that the SSM designates materials from general stock for installation within the secure area, the contractor shall ensure that designated materials are utilized in that manner. Continuously coordinate these procedures with the SSM and their staff.

m. The Contractor shall immediately present materials for inspection and testing, upon request, by the SSM or delegate.

n. The Contractor shall notify the Government not less than 7 days prior to sheathing and/or cladding activities that will enclose wall cavities on secure area perimeters. Advanced notice shall be made to the project SSO for inspection, verification, and documentation of those conditions.

p. Track ownership and store design drawings and specifications in accordance with the requirements listed above.

q. Maintain continuity of secure area and secure area material storage

perimeter(s) for the entirety of construction once CSP implementation has begun.

1.13.2.2 Government Responsibilities

a. Secure Area security oversight and vetting.

b. Re-verification of contractor's vetting of employees as US Citizen or US Person status.

c. If established, the Government is responsible for tracking and validating all access/vehicles/supplies into the construction secure area perimeter with oversight provided by the SSM.

d. If established, the Government is responsible for Secure Area construction inspection and approval.

e. At the end of each work day the construction site will be checked by the Government to verify all workers have departed and the perimeter access door/gate will be secured by the Government and may be randomly checked until the next work day.

f. Once construction proceeds to a point where the construction Secure Area perimeter is defined, the SSM will oversee the process of having Government or CAST surveillance technicians in the secure area during work operations.

g. Once walls/barriers to the Secure Area have been put in place there may be Government or CAST surveillance technicians in each walled off area to maintain secure construction during the build.

h. As required for inspection, the SSM will randomly select materials from general stock for use in construction of the Secure Area.

j. The SSM or delegate will check all site access log information (visitors, workers, security events, access control logs, etc).

1.13.3 Access Within RA, within established Free Zone (AS REQUIRED)

See the design drawings for any anticipated Free Zones for this project. These areas have been previously reviewed by Base Security Forces as acceptable Free Zone perimeters. Contractor shall acknowledge or advise the Government to any intended changes to these boundaries in their SSAMP. Close coordination of these boundaries and the responsibilities listed below are required and will require continuous coordination and fine-tuning through the duration of the Project.

1.13.3.1 Contractor Responsibilities

a. Erect a perimeter fence around the entire Free Zone perimeter with a single securable access point, per plans and specifications.

b. Contractor will conduct initial vetting for workers using e-Verify to confirm all workers are US Citizens or US Persons and present a roster of all workers to the Site Security Manager (SSM, Government) who will verify using birth certificate, passport, or I-9 approved identification. Any additional workers added after the initial roster is submitted will not be allowed access until proper vetting has been completed, which may take up to 30 days.

c. After successful validation of US Citizen or US Person status, the validated construction workers will be added to the access control roster, issued a site access badge and receive a security briefing from the SSM. The security badge shall be in the possession of the worker while on site and shall be required for access to any secure or controlled area.

d. Workers will enter the site through the controlled access point only and must be on the controlled access roster provided to the onsite guard. When required, the contractor shall provide CAGs and/or escorts for proper manning of the controlled access point. Coordinate requirements with Base Security Forces.

e. No Privately Owned Vehicles (POVs) will be authorized within the RA. Only marked commercial and construction vehicles will be allowed access - only after validation through the SSM and inspection and checking at the controlled access point. POV parking for workers will be made available in the vicinity of the Project site, outside the RA.

f. All construction equipment entering the Restricted Area will be validated through the Contractor's security specialist.

g. If the contractor has to perform work outside normal working hours, they will coordinate the requirement as prescribed in 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

h. The contractor shall establish and maintain a materials and stockpile area within the Free Zone for construction material and equipment to minimize escorting requirements outside of the Free Zone perimeter.

j. The Contractor's security specialist will maintain all controlled area access log information (visitors, workers, security events, access control logs, etc), and immediately provide requested documentation to the Government, upon request.

k. Free zone entry point and temporary lighting during any work outside of daylight hours.

l. The Contractor shall maintain a clean and organized construction site. Store/park equipment within the project site as directed by the SSM, in compliance with free zone requirements. Do not store equipment within 30 feet of the free zone perimeter fence(s), unless specifically authorized in writing by the SSM and SFS.

m. Maintain continuity of free zone perimeter(s) for the entirety of establishment and use of the free zone.

1.13.3.2 Government Responsibilities

a. Free Zone security oversight and vetting.

b. Re-verification of contractor's vetting of employees as US Citizen or US Person status.

c. There will be a chain link fence erected around the entire Free Zone perimeter with a single access point that will be manned during work hours by personnel (Contractor provided) tracking and validating

all access/vehicles/supplies to the construction site with oversight provided by the SSM or SFS personnel.

d. At the end of each work day the construction site will be checked by the Government to verify all workers have departed and the site access gate will be secured by the Government and randomly checked until the next work day.

1.13.4 Access Within RA, no Free Zone

The Government's intent is for minimal work to occur outside of an established Free Zone. Some utility connections and similar activities may necessitate such work. When work inside the RA, but outside of a Free Zone is required, the Contractor shall comply with the following:

1.13.4.1 Contractor Responsibilities

a. Contractor will conduct initial vetting for workers using e-Verify to confirm all workers are US Citizens or US Persons and present a roster of all workers to the Site Security Manager (SSM, Government) who will verify using birth certificate, passport, or I-9 approved identification. Any additional workers added after the initial roster is submitted will not be allowed access until proper vetting has been completed, which may take up to 30 days.

b. After successful validation of US Citizen or US Person status, the validated construction workers will be added to the access control roster, issued a site access badge and receive a security briefing from the SSM. The security badge shall be in the possession of the worker while on site and shall be required for access to any secure or controlled area.

c. All construction workers performing work within the RA perimeter will either be SECRET cleared workers or will be escorted (via Contractor-provided escorts or CAGs) at all times while outside an established Free Zone.

d. Workers will enter the site through the controlled access point only and must be on the controlled access roster provided to the onsite guard.

e. No Privately Owned Vehicles (POVs) will be authorized within the RA. Only marked commercial and construction vehicles will be allowed access - only after validation through the SSM and inspection and checking at the controlled access point. POV parking for workers will be made available in the vicinity of the Project site, outside the RA.

f. All construction equipment entering the Restricted Area will be validated through the SSM or SFS.

g. If the contractor has to perform work outside normal working hours, they will coordinate the requirement as prescribed in 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

h. The Contractor will be responsible for direct oversight and escort activities for such work activities, as well as management of the controlled access point managing access to the RA - in coordination with SFS and SSM.

j. The contractor shall not stockpile materials outside of an established Free Zone. Materials shall be stockpiled within a nearby Free Zone perimeter and brought to the work activity site to be prepared and/or installed. Materials not installed during the working day shall be returned to an established Free Zone perimeter unless approved by the Contracting Officer.

1.13.4.2 Government Responsibilities

a. Security oversight and vetting.

b. Re-verification of contractor's vetting of employees as US Citizen or US Person status.

c. At the end of each work day the construction site will be checked by the Government to verify all workers have departed and the work site and will be secured by the Government and randomly checked until the next work day.

d. As required for inspection, the SSM or SFS will randomly select materials from general stock for use in construction.

f. The SSM or SFS will maintain all site access log information (visitors, workers, security events, access control logs, etc).

1.13.5 Access to Controlled Area Work Perimeters (CAWPs), from outside established CA

See the design drawings for any anticipated CAWPs for this project. These areas have been previously reviewed by Base Security Forces as acceptable. Contractor shall acknowledge or advise the Government to any intended changes to these boundaries in their SSAMP. Close coordination of these boundaries and the responsibilities listed below are required and will require continuous coordination and fine-tuning through the duration of the Project.

1.13.5.1 Contractor Responsibilities

a. Erect a perimeter fence around the entire controlled area perimeter with a single securable access point, per plans and specifications.

b. Contractor will conduct initial vetting for workers using e-Verify to confirm all workers are US Citizens or US Persons and present a roster of all workers to the Site Security Manager (SSM, Government) who will verify using birth certificate, passport, or I-9 approved identification. Any additional workers added after the initial roster is submitted will not be allowed access until proper vetting has been completed, which may take up to 30 days.

c. After successful validation of US Citizen or US Person status, the validated construction workers will be added to the access control roster, issued a site access badge and receive a security briefing from the SSM. The security badge shall be in the possession of the worker while on site and shall be required for access to any secure or controlled work area.

d. Workers will enter the site through the controlled access point only and must be on the CAWP roster provided to the onsite guard. Coordinate requirements with Base Security Forces.

e. No Privately Owned Vehicles (POVs) will be authorized within the CAWP. Only marked commercial and construction vehicles will be allowed access - only after validation through the SSM and inspection and checking at the controlled access point. POV parking for workers will be made available in the vicinity of the Project site.

f. All construction equipment entering the CAWP will be validated through the Contractor's security specialist.

g. If the contractor has to perform work outside normal working hours, they will coordinate the requirement as prescribed in 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

h. The contractor shall establish and maintain a materials and stockpile area within the CAWP or within their established construction laydown area for construction material and equipment to minimize requirements inside the CA.

j. The Contractor's security specialist will maintain all CAWP access log information (visitors, workers, security events, access control logs, etc), and immediately provide requested documentation to the Government, upon request.

k. CAWP entry point and temporary lighting during any work outside of daylight hours.

l. The Contractor shall maintain a clean and organized construction site. Store/park equipment within the project site as directed by the SSM, in compliance with applicable requirements. Do not store equipment within 30 feet of the CAWP perimeter fence(s), unless specifically authorized in writing by the SSM and SFS.

m. Maintain continuity of CAWP perimeter(s) for the entirety of establishment and use of the CAWP.

1.13.5.2 Government Responsibilities

a. CAWP security oversight and vetting.

b. Re-verification of contractor's vetting of employees as US Citizen or US Person status.

c. There will be a chain link fence erected around the entire Free Zone perimeter with a single access point that will be manned during work hours by personnel (Contractor provided) tracking and validating all access/vehicles/supplies to the construction site with oversight provided by the SSM or SFS personnel.

d. At the end of each work day the construction site will be checked by the Government to verify all workers have departed and the site access gate will be secured by the Government and randomly checked until the next work day.

1.13.6 Requesting New Free Zones within RA

The Government may approve additional free work zones when deemed appropriate for the work activity(ies) and when such a perimeter reduces oversight and escort burdens on the Government and/or Contractor.

If the Contractor wishes to establish a new free work zone, provide appropriate documentation as an amendment to the approved SSAMP not less than 30 calendar days prior to the anticipated start date. The free zone shall not be considered approved until notified as such by the Contracting Officer.

1.13.7 Requesting New CAWP(s)

The Government may approve additional CAWPs when deemed appropriate for the work activity(ies) and when such a perimeter reduces oversight and escort burdens on the Government and/or Contractor.

If the Contractor wishes to establish a new CAWP, provide appropriate documentation as an amendment to the approved SSAMP not less than 30 calendar days prior to the anticipated start date. The CAWP shall not be considered approved until notified as such by the Contracting Officer.

1.14 INFORMATION ACCESS

Contractor access to classified information is prohibited. When Contractor performance occurs within restricted or controlled areas, or within close physical proximity of classified information, Contractor compliance with various levels of security instructions is required.

1.15 COMMUNICATIONS SECURITY (COMSEC) MONITORING

Contractor personnel are advised that any time they place a call or receive a call from a DoD organization, they are subject to COMSEC procedures, such as monitoring. All communications with DoD organizations are subject to COMSEC review. Telecommunications networks are continually subject to intercept by unfriendly intelligence organizations. The DoD has authorized the military departments to conduct COMSEC monitoring and recording of telephone calls originating from or termination of DoD organizations. The contractor is responsible for ensuring all contractor employees are informed of the provisions of this paragraph.

1.16 RECORDING DEVICES

Cameras, cell phones, computers, radios and any other electronic devices shall not be allowed in any retricted area or secure area perimeter unless specific approval (with letter) is granted from SFS. Approval of any electronic devices is at the discretion of the Government.

The contractor shall request approval for such devices through the US Army Corps of Engineers (USACE) (in collaboration with Base Civil Engineering Squadron and Base Security Forces Squadron), not less than 14 days in advance of required usage. Include approved devices in the approved equipment list.

Cameras, cell phones, computers, radios and any other electronic devices are subject to controlled use within the EAFB CA and associated CAWPs. Guidelines for use of such devices will be reviewed at the preconstruction meeting after construction contract award. The Government reserves the right to prohibit use of such devices if proper protocols and/or procedures are not followed.

1.16.1 Secure Area Sign

Install a sign (minimum 20" x 30") stating the following: "ABSOLUTELY NO ELECTRONIC DEVICES PERMITTED BEYOND THIS POINT UNLESS APPROVED IN WRITING BY THE SITE SECURITY MANAGER" at the secure area access control point.

1.17 RADIOS

The contractor shall provide professional grade, two-way radios (without recording capability, with charging stations) in a quantity necessary for their operation of a project site under the constraints listed herein.

In addition, provide the Government with access to not less than 3 radios for the duration of construction

Provide referenced radios from the time that construction commences on site, through the duration of the project.

CELLULAR PHONES

The contractor will be authorized a reasonable, limited quantity of phones for use within the project secure perimeter to complete the work and meet all safety, quality, and other contract requirements. Phones or recording devices for every individual entering the secure perimeter will not be allowed; devices will only be allowed for key contractor/subcontractor management, quality, safety, etc. Phones with 5G bandwidth is not permitted for use within the secure perimeters. Phones may not be equipped with cameras unless the SSM authorizes use of the camera in writing. Phones without Bluetooth capability are preferred. If phones have Bluetooth capability, that functionality must be disabled at all times while in the secure perimeter. Cameras will only be authorized by the SSM in a reasonable limited quantity to complete the work and meet all safety, quality, and other contract requirements. As part of its SSAMP, the contractor must submit and maintain a list of phones and recording devices that are approved for use and each device must be accounted for when entering and exiting the secure area. All devices must be submitted and approved by the SSM prior to use. Any photos recorded by cameras will be vetted through SSM prior to any use outside the project site or transfer from recording device to other electronic equipment or system. All devices are subject to SSM inspection at any time while in the secure area.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

# EAFB Entry Authority (EAL) Instructions.

## 1.1 General

The Contractor shall be required to prepare and maintain an Entry Authority List (EAL) to allow his workers to have access to Ellsworth AFB and the work site. Base security forces will use this entry authority list to issue appropriate passes to contractor personnel requiring access to the base to perform contract work. Contractor personnel must stop at the Visitor Control Center on their first day of work at the base to receive a base pass and vehicle pass. Individuals must have a driver's license or other picture identification for the personal pass and vehicle registration and insurance verification for a vehicle pass. Contractor personnel shall have these base issued passes on their person at all times while they are on Ellsworth Air Force Base. Base security forces will check the work-site against the list from time to time to assure that those working on the project site are properly documented on the list. Requirements for preparation and maintenance and submittal of the EAL are as follows:

a. The Contractor or his subcontractor shall organize the EAL.

b. The Prime Contractor's list will be first, followed by each subcontractor's list in alphabetical order by company name. Each Contractor or subcontractor list shall be provided on the letterhead of the particular contractor or subcontractor. In the event that a subcontractor does not have letterhead, his list may be provided on the prime contractor's letterhead.

c. The cover letter shall include the Contract Number and Title along with the notice to proceed date and the current contract completion date. It shall also include the normal work schedule for the contractor in terms of days and hours of work.

d. The list or lists shall not be company rosters; but shall contain only the names of personnel expected to need base access over the ensuing period for purposes of accomplishing the contract work.

e. The EAL shall contain the Name and Driver's License Number/State of Issue for each person requiring access to the base to accomplish the contract work. Names shall be arranged in alphabetical order, last name first. The list shall identify primary & alternate work locations for each individual.

### 1.1.1 Copies of EAL

The original EAL and a copy shall be provided to the U.S. Army Corps of Engineers Resident Office. The Resident Office will review and provide required copies to the Visitor Control Center for processing. Additionally, the Contractor shall maintain an up-to-date EAL at the construction site including all sub contractors.

### 1.1.2 Updating EAL

The EAL shall be updated and resubmitted in its entirety for each contractor and subcontractor when changes occur and personnel need access to Ellsworth AFB. The updated list shall reflect

separately the employees who no longer work on the site as well as the addition of new employees requiring access to the work. The number of copies and distribution of the resubmittal shall be the same as for the original list.

1.1.3 Termination of Base Access Passes

The Contractor shall establish procedures to immediately reclaim and turn in to Corps of Engineers Resident Office the base passes of any person, who quits his employment, is terminated, or otherwise no longer requires access to the base. The Contractor shall collect all remaining passes and return them at the conclusion of the contract.

1.2 ENTRY PROCEDURES FOR CONSTRUCTION PROJECTS INSIDE CONTROLLED AREAS

a. All contractors performing work inside established controlled areas on Ellsworth AFB must provide a separate flightline entry authority letter containing the following information:

(1) Contractor's letterhead, contract purpose, and inclusive dates of the contract. This letter must also include the full name and social security number of all personnel requiring entry into the controlled area.

(2) All vehicles required in the controlled area for the project must be listed on the letter with vehicle color, make, year, license plate number, and state of issue.

(3) These personnel must have two forms of identification in his/her possession at all times. At least one form must contain a photograph of the individual. Personnel will not be able to start working within the controlled area until the entry authority letter has been approved.

b. Except for parking in the designated "Contractor POV Parking" area, each vehicle must have the company logo, either painted or placed on inside of windows (no magnetic signs are allowed on sides of vehicles) on each side of the vehicle.

c. Escorted personnel are to remain with the escort official at all times.

d. All vehicles entering the area are subject to search by security forces personnel. The escort official is responsible for processing the contractor through the entry control point, escorting personnel to and from the work area, and assisting in personnel and vehicle searches as required. The escort official is also responsible for providing personnel with an escort briefing.

e. In the event of an emergency that requires evacuation from the area, you will comply with the instructions of your escort official.

f. Workers and drivers planning to work within controlled areas are required to attend and pass a Flightline restrictions drivers training prior to working within the area.

[Example Base Access Request Memo]

# Company Letterhead

SUBJECT: Request for Base Access Badge/Pass 5 MAY 2021

1. The following individuals require access to Ellsworth Air Force Base to perform official duties in support of PROJECT working for PRIME CONTRACTOR. They require access to SITE LOCATION. Their duties will include EXAMPLES OF WORK PERFORMED. Access is required from XX March 2021 to XX December 2021. The Corps of Engineers contract number is W9128FXXXXXX.

2. The individuals listed have been briefed that while on the installation they must comply with all local laws and policies. The failure to comply will result in loss of base access. Each individual understands that they must go to the Security Forces Pass and Registration office to receive their contractor identification badge/pass. They further understand they must have a valid driver's license/Identification card, proof of current registration and insurance while driving on the installation.

3. OPTIONAL PARAGRAPH (When first arriving to the installation the following individuals will need **no escort** before being allowed access to the installation, however an escort may be necessary for the restricted flightline access. Two forms of identification will accompany all persons listed below, at all times when accessing the flightline areas.)

4. I understand it is the unit/company responsibility to collect the badges of terminated employees and to collect the badges at the conclusion of the work that was to be accomplished. Further, I understand that we are responsible to turn the badges/passes in to the Security Forces Pass and Registration office as soon as all work is complete.

| LAST NAME | FIRST NAME | DAYS/HRS OF ACCESS | DOB (MM/DD/YYYY) | DRIVER'S LICENCE # and STATE of ISSUE | POSITION |
|---|---|---|---|---|---|
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PART 2 NOT USED

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3.1 APPENDIX A- CONTRACT DOCUMENT DISTRIBUTION LIST

ATTACHMENTS:

Appendix A - Contract Document Distribution List

AF103OI - 28 CES AF Form 103 Base Civil Engineer Work Clearance Operating Instruction

AF103 - Base Civil Engineer Work Clearance Request

Project Sign Details

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OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS
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PART 1 GENERAL

Attachments:
Appendix A - Contract Document Distribution List
AF103OI - 28 CES AF Form 103 Base Civil Engineer Work Clearance Operating Instruction
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Project Sign Details

1.1 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE

In accordance with FAR 31.105(d)(2)(i)(b), for the predetermined schedule of construction equipment use rates, use Engineer Pamphlet (EP) 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule. Copies of each regional schedule may be obtained through the following internet site:

https://www.publications.usace.army.mil/USACE-Publications/Engineer-Pamphlets/ on pages 10 and 11 of 13.

1.2 CONTRACTOR SUPPLY AND USE OF ELECTRONIC SOFTWARE FOR PROCESSING CONSTRUCTION WAGE RATE REQUIREMENTS STATUTE CERTIFIED LABOR PAYROLLS

a. Use a commercially-available electronic system to process and submit certified payrolls electronically to the Government. The requirements for preparing, processing and providing certified labor payrolls are established by the Wage Rate Requirements statute.

b. Obtain and provide for all access, licenses, and other services required to provide for receipt, processing, certifying, electronically transmitting to the Government, and storing weekly payrolls and other data required for the Contractor to comply with the Wage Rate Requirements statute. Use the electronic payroll service to prepare, process, and maintain the relevant payrolls and basic records during all work under this construction contract. The electronic payroll service must be capable of preserving these payrolls and related basic records for the required three years after contract completion. Obtain and provide electronic system access to the Government, as required to comply with the Wage Rate Requirements over the duration of the construction contract.

c. The Contractor's provision and use of an electronic payroll processing system must meet the following basic functional criteria:

(1) commercially available;

(2) compliant with appropriate Wage Rate Requirements statute payroll provisions in the FAR;

(3) able to accommodate the required numbers of employees and subcontractors planned to be employed under the contract;

(4) capable of producing an Excel spreadsheet-compatible electronic output of weekly payroll records for export into an Excel spreadsheet to be imported into the contractor's mode of Resident Management System 3.0;

(5) demonstrated security of data and data entry rights;

(6) ability to produce Contractor-certified electronic versions of weekly payroll data;

(7) ability to identify erroneous entries and track the data/time of all versions of the certified Wage Rate Requirements statute payrolls submitted to the government over the life of the contract;

(8) capable of generating a durable record copy in a Compact Disc (CD) or Digital Versatile Disc (DVD) and Portable Document Format (PDF) file record of data from the system database at the end of the contract closeout. This durable record copy of data from the electronic payroll processing system must be provided to the Government during contract closeout.

d. All Contractor-incurred costs related to the Contractor's provision and use of an electronic payroll processing service must be included in the Contractor's price for the overall work under the contract. The costs for compliance with the Wage Rate Requirements statute by using electronic payroll processing services must not be a separately bid or reimbursed item under this contract.

## 1.3 VETERANS EMPLOYMENT EMPHASIS FOR U.S. ARMY CORPS OF ENGINEERS CONTRACTS

In addition to complying with the requirements outlined in FAR Part 22.13, FAR Provision 52.222-38, FAR Clause 52.222-35, FAR Clause 52.222-37, DFARS 222.13 and Department of Labor regulations, U.S. Army Corps of Engineers (USACE) contractors and subcontractors at all tiers are encouraged to promote the training and employment of U.S. veterans while performing under a USACE contract. While no set-aside, evaluation preference, or incentive applies to the solicitation or performance under the resultant contract, USACE contractors are encouraged to seek out highly qualified veterans to perform services under this contract. The following resources are available to assist USACE contractors in their outreach efforts:

- U.S. Department of Labor Veterans’ Employment and Training Service (VETS):
https://www.dol.gov/vets/
- Federal Veteran Employment Information: https://www.fedshirevets.gov/
- Veterans Opportunity to Work (VOW) Program:
https://www.benefits.va.gov/vow/
- U.S. Army Warrior Transition Command Employment Index:
https://wct.army.mil/modules/employers/index.html
- Hiring Our Heroes: https://www.uschamberfoundation.org/hiring-our-heroes

## 1.4 COMPLETION OF WORK

See FAR 52.211-10 COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984).

## 1.5 CONTRACTOR PERFORMANCE EVALUATIONS

Federal Acquisition Regulation (FAR) Subpart 36.201(Evaluation of Contractor Performance) requires evaluation of the construction

contractor's performance throughout the contract period of performance. For construction contracts valued at or above $700,000.00, including all modifications, the USACE will evaluate Contractor's performance using the web-based Contractors Performance Assessment Reporting System (CPARS). After the USACE drafts an evaluation (interim or final), the Contractor will have the opportunity to access, review, comment and either concur or non-concur with the evaluation in the CPARS system for a period of 60 days. Access to the CPARS system requires either specific software called PKI certification (recommended method) or a username and password. The PKI certification is a Department of Defense recommendation and to provide security in electronic transactions. The certification software could cost approximately $110 - $125 per certificate per year and may be purchased from an External Certificate Authorities (ECA) vendor. Current information about the PKI certification process and contacting vendors can be found on the web site: https://www.cpars.gov.

1.6 ANTITERRORISM (AT)/OPERATIONS SECURITY (OPSEC) PROVISIONS

1. AT Level I Training

All Contractor employees, to include subcontractor employees, requiring access to Army installations, facilities and controlled access areas shall complete AT Level I awareness training within 30 calendar days after contract start date or effective date of incorporation of this requirement into the contract, whichever is applicable. Upon request, the Contractor shall submit certificates of completion for each affected Contractor employee and subcontractor employee, to the COR or to the contracting officer (if a COR is not assigned), within 5 calendar days after completion of training by all employees and subcontractor personnel. AT Level I awareness training is available at the following website: https://jko.jten.mil/courses/AT-level1/launch.html; or it can be provided by the Requiring Activity Anti-Terrorism Officer (RA ATO) in presentation form which will be documented via memorandum.

2. Access and General Protection/Security Policy and Procedures

All contractor and all associated sub-contractors employees shall comply with applicable installation, facility and area commander installation/facility access and local security policies and procedures (provided by government representative). The contractor shall also provide all information required for background checks to meet installation/facility access requirements to be accomplished by installation Provost Marshal Office, Director of Emergency Services or Security Office. Contractor workforce must comply with all personal identity verification requirements (FAR clause 52.204-9, Personal Identity Verification of Contractor Personnel) as directed by DOD, HQDA and/or local policy. In addition to the changes otherwise authorized by the changes clause of this contract, should the Force Protection Condition (FPCON) at any installation or facility change, the Government may require changes in contractor security matters or processes.

2b. for Contractors Who Do Not Require CAC, But Require Access To A Dod Facility Or Installation

Contractor and all associated sub-contractors employees shall comply with adjudication standards and procedures using the National Crime Information Center Interstate Identification Index (NCIC-III) and Terrorist Screening Database (TSDB) (Army Directive 2014-05 / AR 190-13), applicable installation, facility and area commander installation/facility access and

local security policies and procedures (provided by government representative, as NCIC and TSDB are available).

3. Not Used

4. Suspicious Activity Reporting Training (e.g. iWATCH, CorpsWatch, or See Something, Say Something)

The contractor and all associated sub-contractors shall receive a brief/training (provided by the RA) on the local suspicious activity reporting program. This locally developed training will be used to inform employees of the types of behavior to watch for and instruct employees to report suspicious activity to the project manager, security representative or law enforcement entity. This training shall be completed within 30 calendar days of contract award and within 30 calendar days of new employees commencing performance with the results reported to the COR NLT 5 calendar days after the completion of the training.

5. Contractor Employees Who Require Access to Government Information Systems.

Not Applicable

6. OPSEC Standing Operating Procedure/Plan

Not Applicable

7. OPSEC Training

All new contractor employees will complete Level I OPSEC Training within 30 calendar days of their reporting for duty. Additionally, all contractor employees must complete annual OPSEC awareness training. The contractor shall submit certificates of completion for each affected contractor and subcontractor employee, to the COR or to the contracting officer (if a COR is not assigned), within 5 calendar days after completion of training. OPSEC awareness training is available at the following websites: https://www.iad.gov/ioss/ or http://www.cdse.edu/catalog/operations-security.html; or it can be provided by the RA OPSEC Officer in presentation form which will be documented via memorandum.

8. Information Assurance (IA)/Information Technology (IT) Training

Not Applicable

9. Information Assurance (IA)/Information Technology (IT) Certification

Not Applicable

10. Not Used

11. Not Used

12. Handling or Access to Classified Information.

Not Applicable

13. Will be Escorted in Areas Where They May be Exposed to Classified and/or Sensitive Materials and/or Sensitive or Restricted Areas

If applicable, all contract employees, including subcontractor employees who are not in possession of the appropriate security clearance or access privileges, will be escorted in areas where they may be exposed to classified and/or sensitive materials and/or sensitive or restricted areas.

14. Contractor Company to Obtain a Facility Clearance and Individual Clearances at the Appropriate Level

The Prime Contractor Company must have (or will have) a Facility Clearance (FCL) at the appropriate level (IAW the NISPOM DOD 5220.22-M and AR 380-49) prior to the start of the contract awarded period of performance. Contractor personnel performing work under this contract must have the required security clearance, per AR 380-67, at the appropriate level at the start of the period of performance. Security Clearances and FCL requirements are required to be maintained for the life of the contract IAW the DD254 attached to the contract. If no FCL, the supporting Government Contracting Activity will sponsor the prime contract company in obtaining the FCL.

15. Pre-Screen Candidates using E-Verify Program

The Contractor must pre-screen Candidates using the E-verify Program ( http://www.uscis.gov/e-verify) website to meet the established employment eligibility requirements. The Vendor must ensure that the Candidate has two valid forms of Government issued identification prior to enrollment to ensure the correct information is entered into the E-verify system. An initial list of verified/eligible Candidates must be provided to the COR no later than 3 business days after the initial contract award.

16. Required Armed Security Guards

Not Applicable

17. Threat Awareness Reporting Program (TARP) Training

All new contractor employees will complete annual Threat Awareness and Reporting Program (TARP) Training provided by a Counterintelligence Agent, IAW AR 381-12. The contractor shall submit certificates of completion for each affected contractor and subcontractor employee(s) or a memorandum for the record, to the COR or to the contracting officer (if a COR is not assigned), within 5 calendar days after completion of training. Authorized webbased TARP training for CAC card holders is available at the following website: https://www.lms.army.mil. Log in using CAC and search for "TARP". The same training is available without a CAC at https://securityawareness.usalearning.gov/ by launching the course "Counterintelligence Awareness and Reporting Course for DOD".

1.7 ORDER OF WORK

See Section 01 14 00 WORK RESTRICTIONS.

1.8 CONTRACT DRAWINGS AND SPECIFICATIONS

1.8.1 SETS FURNISHED

Make copies of conformed specifications with amendments incorporated. Utilize the bid drawings and specifications as amended in the performance of the work until the conformed specifications and contract drawings

(i.e., bid drawings that have been posted with all amendment changes) are mailed or sent electronically to the Contractor. See Appendix A for Document Distribution list. See paragraph below for contract drawing reproduction and distribution requirements. The work must conform to the contract drawings, set out in the drawing index, all of which form a part of these specifications. The work must also conform to any of the standard details bound or referenced herein.

1.8.2 REPRODUCTION AND DISTRIBUTION

Reproduce multiple legible hard copy sets (half-size English unless directed otherwise) of contract drawings from Government provided read-only Adobe Acrobat.pdf file drawings. Within 14 calendar days after receipt of conformed specifications and drawings containing read-only Adobe Acrobat.pdf drawing files, provide legible hard copy drawing and conformed specification sets to the addressees contained in the Contract Document Distribution List for Project in Appendix A to this specification. The Government will process no progress payments prior to receipt of the legible contract drawings and conformed specification sets. After receipt and distribution of the legible hard copy drawing and conformed specification sets, the Government will provide the Contractor with editable CAD file drawings (format defined in Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS). Prepare final record or as-built drawings as defined in Section 01 78 39.00 24 AS-BUILT DRAWINGS.

1.8.3 NOTIFICATION OF DISCREPANCIES

Check all drawing files furnished by the Government immediately upon their receipt and promptly notify the Contracting Officer of any discrepancies. Follow dimensions marked on drawings in lieu of scale measurements. Enlarged plans and details govern where the same work is shown at smaller scales. All scales shown are based on a standard drawing size of 22" x 34". If any other size drawings are furnished or plotted adjust the scales accordingly. Advise sub-contractors of the above. Compare all drawings and verify the figures before laying out the work. Contractor will be responsible for any errors which might have been avoided thereby.

1.8.4 OMISSIONS

Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, does not relieve the Contractor from performing such omitted or misdescribed details of the work but work must be performed as if fully and correctly set forth and described in the drawings and specifications.

1.9 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit items below in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Contractor Trailer Area(s) Lay-Down Plan; G, RO

SD-02 Shop Drawings

Equipment Room Drawings; G-RO.

1.10 CONCURRENT CONSTRUCTION

Construction work closely related to and/or located at the site of the work under a concurrent contract will be in progress simultaneously with work under this contract (as described in the design drawings). Cooperate with others as necessary in the interest of timely completion of all work. In the event of interference, notify the Contracting Officer immediately for resolution.

All contractors involved in performing B-21 facilities beddown work will be required to participate in weekly coordination meetings throughout their project's respective periods of performance.

1.11 PAYMENT

1.11.1 PROMPT PAYMENT ACT

Pay requests authorized in GENERAL CONDITIONS (CONTRACT CLAUSES) clause: "Payments Under Fixed-Price Construction Contracts", will be paid pursuant to the clause, "Prompt Payment for Construction Contracts". Submit pay requests on ENG Form 93 and 93a, "Payment Estimate-Contract Performance" and "Continuation". All information and substantiation required by the identified contract clauses must be submitted with the ENG Form 93, and the required certification included on the last page of the ENG Form 93a, signed by an authorized contractor official and dated when signed. The designated billing office is the Office of the Area Engineer.

1.11.2 PAYMENT FOR MATERIALS DELIVERED OFFSITE

a. Pursuant to Federal Acquisition Regulation (FAR) 52.232-5, Payments Under Fixed Price Construction Contracts, materials delivered to the contractor at locations other than the site of the work may be taken into consideration in making payments, if included in payment estimates and if all the conditions of the General Provisions are fulfilled. Payment for items delivered to locations other than the work site are limited to:

(1) Materials required by the technical provisions; or

(2) Materials that have been fabricated to the point where they are identifiable to an item of work required under this contract; or

(3) Items specifically listed below in paragraph b.

b. Payment for materials delivered off-site must be made only after receipt of paid invoices listing the value of material and labor incorporated in the items along with a canceled check showing the prime contractor's title to the items delivered off site. Payment for materials delivered off-site must be limited to the following items:

-Structural Steel as defined by Section 05 12 00 of this RFP.
-Metal Wall panels as defined by Sections 07 42 13 of this RFP.

1.12 AVAILABILITY OF UTILITY SERVICES

All reasonably required amounts of domestic water and electricity will be

made available to the Contractor by the Government from existing system outlets and supplies. The Contractor is reponsible to, at their own expense, make all temporary connections and install distribution lines. Furnish to the Contracting Officer a complete system layout drawing showing type of materials to be used and method of installation for all temporary electrical systems. Make arrangements with the Using Service, through the Contracting Officer, as to the method of determining the amount of water and electricity to be used by and the method of payment therefore. All temporary lines must be maintainedin a workmanlike manner satisfactory to the Contracting Officer and removed by the Contractor in like manner prior to final acceptance of the construction. Normal quantities of electricity and water used to make final tests of completely installed systems will be furnished by the Government.

1.13 UTILITY SERVICE INTERRUPTIONS

Submit written notification not less than 15 calendar days in advance of each interruption of each utility and communication service to or within existing buildings and facilities being used by others. No single outage will exceed 4 hours unless approved in writing. The time and duration of all outages will be coordinated and approved with the Using Agency by the Contracting Officer. See Section 01 14 00 WORK RESTRICTIONS for additional requirements.

1.14 DIGGING PERMITS AND ROAD CLOSINGS

Allow 14 calendar days from date of written application to receive permission to dig and to close roads. Only close roads one lane at a time and allow vehicular traffic to pass through the construction area. Flag work on or near roadways in accordance with the safety requirements in Safety and Health Requirements Manual EM 385-1-1, which forms a part of these specifications. Do not cause blockage of work located along the alert force route and maintain unobstructed access for alert force traffic at all times. See Section 01 14 00 WORK RESTRICTIONS for additional requirements.

1.15 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER

a. This provision specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the GENERAL CONDITIONS (CONTRACT CLAUSES) clause entitled "Default: (Fixed-Price Construction)." In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

(1) The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

(2) The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

b. The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather

dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY
WORK DAYS BASED ON (5) DAY WORK WEEK

| | |
|---|---|
| Jan | 9 |
| Feb | 9 |
| Mar | 8 |
| Apr | 5 |
| May | 6 |
| Jun | 5 |
| Jul | 4 |
| Aug | 3 |
| Sep | 3 |
| Oct | 3 |
| Nov | 4 |
| Dec | 10 |

c. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the contract, the contractor will record on the RMS daily CQC report, any occurrence of adverse weather and resultant impact to normally scheduled work, within 24 hours of the event. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day. Describe in the RMS daily CQC reports the critical path item that is being affected and provide the critical path activity number(s) from the current schedule. The COR must acknowledge and accept the agreed upon occurrence of each adverse weather delay in RMS for the delays to be considered as adverse weather delays.

At the end of each month, identify the number of actual adverse weather delay days that includes days impacted by actual adverse weather (even if adverse weather occurred in previous month), calculated chronologically from the first to the last day of each month, and recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph b. above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the GENERAL CONDITIONS (CONTRACT CLAUSES) clause entitled "Default (Fixed Price Construction)". (ER 415-1-15)

1.16 INSURANCE REQUIRED

In accordance with GENERAL CONDITIONS (CONTRACT CLAUSES) clause: "Insurance Work on a Government Installation," procure the following minimum insurance:

| Type | Amount |
|---|---|
| Workmen's Compensation and Employer's Liability Insurance | $100,000 |
| General Liability Insurance | $500,000 per occurrence |
| Automobile Liability Insurance | |
| Bodily injury | $200,000 per person and $500,000 per occurrence |
| Property damage | $ 20,000 per occurrence |

(Coverages per FAR 28.307-2)

## 1.17 SECURITY REQUIREMENTS

### 1.17.1 Contractor's Employee Identification

The Contractor is responsible for furnishing to each employee and for requiring each employee engaged on the work to display such identification as may be approved and directed by the Contracting Officer. Deliver all prescribed identification immediately be delivered to the Contracting Officer, for cancellation upon release of any employees. When the contract involves work in restricted security areas, only employees who are U.S. citizens will be permitted to enter. Proof of U.S. citizenship is required prior to entry. When required by the Contracting Officer, obtain and submit fingerprints of all persons employed or to be employed on the project. (Based on FAR 52.204-2)

### 1.17.2 Entry Requirements

See Section 01 14 00 WORK RESTRICTIONS.

## 1.18 CONTRACTOR QUALITY CONTROL (CQC)

See Section 01 45 00.00 10 QUALITY CONTROL.

## 1.19 NONDOMESTIC CONSTRUCTION MATERIALS

The list of excepted nondomestic construction materials or their components referenced in the Buy American Construction Material Contract Clauses includes the list set forth in paragraph 25.104 of the Federal Acquisition Regulation.

## 1.20 DAILY WORK SCHEDULES AND WEEKLY COORDINATION MEETINGS

In order to closely coordinate work under this contract, prepare a written agenda/meeting minutes and attend a weekly coordination meeting with the Contracting Officer and Using Service at which time the Contractor must submit for coordination and approval, their proposed daily work schedule for the next two week period. Provide a copy of modifications (MODs), Serial Letters, Requests for Information (RFIs)and any other information that is needed in the minutes of the meeting. Include required temporary utility services, time and duration of interruptions, and protection of adjoining areas with the Contractor's proposed 2-week work schedule. At this meeting, the Contractor must also submit their schedule of proposed dates and times of all preparatory inspections to be performed during the next 2 weeks. The items of work listed on the proposed 2-week schedule are to be keyed to the NAS by activity number and description for each activity anticipated to be performed during the next 2-week period. Coordination action by the Contracting Officer relative to these schedules will be accomplished during these weekly meetings. Daily reports must be completed and given to the Contracting Officer or Representative within 24 hours of work. All official correspondence such as serial letters and RFIs, with attachments are to be provided in one hardcopy original with original signatures and one electronic (Adobe pdf format) copy by email. The Government will consider the correspondence to be received when the official hardcopy or electronic copy is received by the designated office. See Section 01 14 00 WORK RESTRICTIONS for additional requirements.

1.21 AS-BUILT DRAWINGS

See 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/CAD) REQUIREMENTS.

1.22 SIGN

On commencement of work on this project, furnish and erect the temporary sign in the location selected by the Contracting Officer near the project site. Maintain the sign in good condition through the project construction period. Upon completion of the project remove the sign from the premises. The project sign must conform to standard drawing bound herein. A decal of the "Engineer Castle" and the U. S. Air Force emblem will be furnished the Contractor upon request.

1.23 EQUIPMENT ROOM DRAWINGS

Prior to construction, prepare and submit room plans for all mechanical, electrical, and communication rooms or similar areas. The plans must be consolidated for all trades, be to scale, and show all pertinent structural features. In addition, other items such as doors, windows, and cabinets required for installation and which will affect the available space, must be shown. All mechanical and electrical equipment and accessories must be shown to scale in plan and elevation and/or section in their installed positions. All duct work and piping must be shown.

1.24 CONTRACTOR FURNISHED EQUIPMENT DATA

See Section 01 78 36.00 24 WARRANTY OF CONSTRUCTION for Contractor Furnished Equipment Data to be submitted as part of the Warranty Equipment Booklet.

1.25 GOVERNMENT FIELD OFFICE

The contractor shall provide a new stand-alone weather tight government only field office on the site indicated in the design drawings. Coordinate and install all required utility connections for the facility to include water, sanitary sewer, gas (as required), electrical, and communications. Connections must be coordinated, submitted, and approved by respective Government and privatized utility system owners.

a. The location and configuration of the Government field office shall be included in the Contractor Trailer Area(s) Lay-Down plan.

b. Parking areas shall be gravel or existing hard paving to prevent mud and be reserved for government employees only. Provide and maintain government only parking for a minimum of 8 vehicles. Demolish, patch, and repair any paving to match existing for any associated trailer or utility installation requirements.

c. Provide office suitable in size (minimum 500 SF) to accommodate six cubicles (minimum 6 ft x 8 ft), small conference room (seating six persons), restroom, and kitchen/break area.

d. Furnish and maintain drinking water facilities, adequate lighting, high speed internet (minimum ISP mid-tier 200 Mbps with spare line provision), air-conditioning, heating equipment, and an enclosed restroom. Contractor is responsible for payment of all utilities (including internet) for Government office. ISP on base is Midcontinent Communications (Midco). Web address: www.midco.com. Phone:

1(800)888-1300.

e. Provide all furniture to include cubicles, chairs, small meeting/break table, drafting table & plan rack, trash cans, etc. Cubicles shall be a minimum of 6 ft x 8 ft and contain adequate storage for drawings, plans, documents, etc. Used furniture in good condition is acceptable. Provide (1) minimum 75" high definition TV/Monitors with stands/mounts for the meeting table/area.

f. Provide kitchen/break area to include sink, refrigerator (minimum 8 cu-ft), coffee pot and microwave.

g. Provide color printer capable of copying, printing 11 in x 17 in, and scanning. Printer must be from USACE approved devices list. Replace ink and paper as necessary throughout the project. Provide IT support for equipment setup, troubleshooting, and maintenance.

h. Equip entrance doors with a substantial lock.

j. Provide once a week janitorial service. Janitorial service shall include trash removal, light dusting, floor sweeping and mopping, restroom cleaning and carpet vacuuming. Provide supplies to include hand soap, toilet paper, paper towels, cleaning supplies and trash can liners throughout.

k. Provide pest control as necessary.

l. Provide snow removal for parking areas, vicinity of field office and walkways between building and project site. A snow event is when 2 inches (or greater) of snow falls in a 24 hour period. Provide a snow shovel and broom for snow removal for events less than 2 inches.

m. Provide boot brush at each entrance.

n. Provide weed control and mowing around the trailer complex.

o. Perform repairs as needed for routine maintenance, weather damage (high winds, hail, water damage, etc.) during construction.

p. Provide sign mounted on exterior of building indicating it is the USACE office. Sign shall be a minimum of 18 in x 24 in. Coordinate sign content and location with the COR.

q. At completion of the project, the office & conference room, including furniture will remain the property of the Contractor and be removed from the site. Restore area to previous condition.

r. The Contractor may, at their option, furnish and maintain a trailer-type mobile office acceptable to the Contracting Officer and providing as a minimum the facilities specified above. Trailers shall be in new condition and present a clean and neat exterior appearance.

s. All contractor and contractor-provided Government trailers shall be provided with signage that indicates company name and Primary POC phone number readily visible on the exterior of the trailer facility.

1.26 ASBESTOS AND LEAD

a. The Contractor is warned that inhalation of asbestos and lead has

been associated with health hazards.

b. Asbestos-containing materials may be present in area(s) where contract work is to be performed. All contract work activities where the potential exists for worker exposure to airborne asbestos fibers shall be performed in accordance with the requirements set forth in Section 02 82 00 ASBESTOS REMEDIATION.

c. Lead may be present in some painted surfaces which are scheduled for removal/renovation. See Section 02 83 00 LEAD REMEDIATION for locations and proper procedures.

1.27 PARTNERING

a. Contractor shall host a formal partnering session within 45 calendar days of contract award or as coordinated and approved by the Government. 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 (an associated representatives), USACE, AFCEC, Contractor, key subcontractors and the Designer of Record are required to participate in the Partnering process. This partnership between the Contractor and the Government will be voluntary and its implementation will not be part of the contract requirements nor will it result in a change to contract price or terms.

b. Host the Formal Partnering session with key personnel from the project team including both Contractor and Government personnel near Ellsworth Air Force Base (in the Rapid City area). 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.

c. 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.

d. The Initial Partnering Session must be a duration of at least 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 Post-Award Kickoff Meeting.

e. 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.

f. 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.

g. Host follow-on Partnering Sessions at approximately six-month intervals (minimum of 4 additional sessions) 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.

1.28 PROFIT

a. Use the weighted guidelines method of determining profit on any equitable adjustment change order or modification issued under this contract. The profit factors must be as follows:

| Factor | Rate | Weight | Value |
|---|---|---|---|
| Degree of Risk | 20 | See Item | |
| Relative difficulty of work | 15 | b. below | |
| Size of Job | 15 | | |
| Period of performance | 15 | | |
| Contractor's investment | 5 | | |
| Assistance by Government | 5 | | |
| Subcontracting | 25 | | |
| | 100 | | |

b. Based on the circumstances of each procurement action, each of the above factors must be weighted from .03 to .12 as indicated below. Obtain the value by multiplying the rate by the weight. The value column when totaled indicates the fair and reasonable profit percentage under the circumstances of the particular procurement.

(1) Degree of Risk. Where the work involves no risk or the degree of risk is very small, the weighting should be .03; as the degree of risk increases, the weighting should be increased up to a maximum of .12. Lump sum items will have, generally, a higher weighted value than the unit price items for which quantities are provided. Other things to consider: the portion of the work to be done by subcontractors, nature of work, where work is to be performed, reasonableness of negotiated costs, amount of labor included in costs, and whether the negotiation is before or after performance of work.

(2) Relative Difficulty of Work. If the work is most difficult and complex, the weighting should be .12 and should be proportionately reduced to .03 on the simplest of jobs. This factor is tied in to some extent with the degree of risk. Some things to consider: the nature of the work, by whom it is to be done, where, and what is the time schedule.

(3) Size of Job. All work not in excess of $100,000 shall be weighted at .12. Work estimated between $100,000 and $5,000,000 shall be proportionately weighted from .12 to .05.

(4) Periods of Performance. Jobs in excess of 24 months are to be weighted at .12. Jobs of lesser duration are to be proportionately weighted to a minimum of .03 for jobs not to exceed 30 days. No weight where additional time not required.

(5) Contractor's Investment. To be weighted from .03 to .12 on

the basis of below average, average, and above average. Things to consider: amount of subcontracting, mobilization payment item, Government furnished property, equipment and facilities, and expediting assistance.

(6) Assistance by Government. To be weighted from .12 to .03 on the basis of average to above average. Things to consider: use of Government-owned property, equipment and facilities, and expediting assistance.

(7) Subcontracting. To be weighted inversely proportional to the amount of subcontracting. Where 80 percent or more of the work is to be subcontracted, the weighting is to be .03 and such weighting proportionately increased to .12 where all the work is performed by the Contractor's own forces.

## 1.29 LABOR CONDITIONS APPLICABLE TO TEMPORARY FACILITIES

It is the position of the Department of Defense that the Davis-Bacon Act, 40 U.S.C. 276a is applicable to temporary facilities such as job headquarters, tool yards, batch plants, borrow pits, sandpits, rock quarries, and similar operations, provided they are dedicated exclusively, or nearly so, to performance of the contract or project, and provided they are adjacent or virtually adjacent to the site of the work and are established after receipt of the proposal or bid. Clause "Payrolls and Basic Records" of the GENERAL CONDITIONS (CONTRACT CLAUSES) is applicable to such operations.

## 1.30 DRAWING SCALES

All scales shown are based on a standard drawing size of 22" x 34". If any other size drawings are furnished or plotted, the contractor adjust the scales accordingly. The Contractor must also advise their sub-contractors of the above.

## 1.31 WAGE RATE APPLICATION

### 1.31.1 Building Schedule

Applicable to all building construction and work up to 5 feet outside of the building.

### 1.31.2 Heavy and Highway Schedule

Applicable to all work not properly classified as building.

## 1.32 FEDERAL HOLIDAYS

The following Federal legal holidays are observed by this installation:

| | |
|---|---|
| New Year's Day | 1 January |
| Martin Luther King's Birthday | Third Monday in January |
| President's Day | Third Monday in February |
| Memorial Day | Last Monday in May |
| Juneteenth | 19 June |
| Independence Day | 4 July |
| Labor Day | First Monday in September |
| Columbus Day | Second Monday in October |
| Veterans Day | 11 November |
| Thanksgiving Day | Fourth Thursday in November |

Christmas Day 25 December

If a wage determination applies the number of holidays specified on it, it has priority over this requirement.

1.33 BASE HOURS

See Section 01 14 00 WORK RESTRICTIONS. Access to the base during other times must be requested in writing from the Contracting Officer and will be granted only for extenuating circumstances. Federal Holidays and weekends are considered as scheduled non-workdays.

1.34 UPKEEP OF ROADWAYS WITHIN A MILITARY INSTALLATION

In addition to the requirements of GENERAL CONDITIONS (CONTRACT CLAUSES) clause "Operations and Storage Areas", the Contractor must comply with the following requirements. Keep all military installation roads, public roads and streets used or affected by construction operations open to traffic at all times during the construction period unless otherwise specified or directed by the Contracting Officer. Keep military installation roads and areas adjacent to the construction site free of debris including litter, waste construction material and mud which are generated by construction operations. Cleaning of roads and areas affected by construction operations must be done on a continual basis. Drainage from the roads must not be obstructed by construction work. Road damage resulting from construction operations must be repaired by the contractor to the satisfaction of the Contracting Officer at no additional cost to the Government.

1.35 COST AND TIME IMPACT (CTI) LOG

a. Any changes with an absolute value under the Simplified Acquisition Threshold (SAT) at the time of initiation of the change and within the Administrative Contracting Officer's (ACO) authority, may be executed using the Cost and Time Impact Log (CTI Log) processes as described herein. The purpose of the CTI Log is to provide efficient and effective change management process for the mutual benefit of the Government and the Contractor while partnering to execute this contract.

b. The CTI Log process is a collaborative, proactive, and efficient change management process. In general, the CTI Log process is as described below.

1. The CTI Log is designated for use on work items determined to be changes where individual costs are anticipated to be less than the SAT. The process starts with a discussion between USACE on-site Contracting Officer's Representative (COR) or ACO and the prime contractor's authorized field representative. If it appears the issue cannot be resolved through a no-cost clarification of the contract requirements, the USACE COR will request the contractor to submit a confirming Request for Information (RFI). Where the solution to the problem is not apparent and not initially resolvable at the field level, the Contractor may submit to USACE a “non-confirming” RFI and USACE shall provide technical direction. If the absolute value of the change is anticipated to exceed the SAT, the contractor will be advised that a Request for Proposal (RFP) for the change will be forthcoming and that the CTI Log process shall not be utilized.

2. The contractor submits the confirming RFI identifying the potential Cost and/or Time impact issue as previously discussed between the USACE COR and the contractor's field representative, along with a proposed solution. In addition to the technical details, the RFI shall contain, to the maximum extent practicable, a proposal for the change from the contractor with an acceptable breakdown of all costs (representing both the prime and each of the applicable subcontractors' costs) to include labor, equipment and material. Time impacts, if applicable, must include a Time Impact Analysis (TIA) of work activities. The prime and subcontractor(s) will provide their markups for each of the individual changes as they arise, to include profit development in accordance with (IAW) the alternate Weighted Profit Guidelines approach per UAI 5115.404-73. If mutually agreed upon by both the Government and Contractor, the Contractor may submit the confirming RFI without the detailed cost proposal and/or the Time Impact Analysis, but shall contain a ROM of cost impacts and time impacts. If it is mutually agreed that the Contractor’s cost proposal and TIA may not be included in the confirming RFI, the Contractor shall submit both the proposal and TIA as soon as practicable or by the date specified in the Government’s response to the RFI, whichever
is sooner.

3. If the proposal and TIA are included in the RFI from the Contractor, the Government shall evaluate the Contractor’s technical recommendation in the RFI, the Contractor’s proposal, and the TIA. When the technical solution is determined and any cost and/or time impacts are discussed, negotiated (if necessary), and determined to be fair and reasonable, the Government ACO will return the RFI with the technical solution and note that the formal price and time agreement will be captured on the CTI Log. Under no circumstances will the RFI response act as a Notice to Proceed (NTP) to incur increased costs or time impacts. The official NTP for the applicable change will be granted upon signing of the CTI Log. If the RFI is submitted and signed by the Government without cost and time impacts known, the Government shall return the RFI with the technical direction and request the proposal and TIA by an established suspense date. In either instance, the CTI Log will note the agreed upon price for the change (if any), time extension (if any), and will establish the NTP for the technical direction captured in the RFI.

4. After arriving at a bilateral agreement on price and time impacts associated with the change, the ACO and the contractor’s representative will enter the RFI number and the agreed upon "reasonable price" on the contract CTI Log. At this time, the ACO will electronically sign the applicable log entries, authorizing the contractor to proceed with the scope described by the RFI and at the reasonable price agreed upon. The contractor's authorized representative must also acknowledge the cost and time impact by signing the CTI Log item, prior to proceeding with the work. The official NTP will occur when both the Government and Contractor have both signed the CTI Log.

5. When the aggregate absolute value of changes approaches the appointed ACO's warrant threshold, the individual CTI Log entries (and associated RFIs) shall be captured in a single modification

document (SF 30). The "SCOPE" paragraph of the modification will contain a summary list of the incorporated CTI Log items. These aggregate modifications will be processed at least once every month, at a different interval as mutually agreed upon, or when expedited processes are needed to pay for critical features of work such that subcontractors have the ability to bill for work completed in the field. The ACO will sign the SF 30 and provide to the contractor for its signature and return. After the SF30 is executed, the Contractor can bill for the earnings included in the associated CTI Log items listed on the SF30.

6. The CTI Log process may be utilized during the performance of this contract unless termination or suspension of this change management process is desired by either party.

PART 2 NOT USED

PART 3 EXECUTION

## 3.1 APPENDIX A- CONTRACT DOCUMENT DISTRIBUTION LIST

NOTE: Each of the quantities indicated below are for hardcopy sets of the indicated media. CD/DVD shall include PDF copies of the full-size drawings set and the project specifications.

| Addressee | No. of Sets Drawings | | |
|---|---|---|---|
| | CD/DVD | Half-size | Full-size |
| Omaha District Office<br>Attn: CENWO-PMM (Andy Temeyer)<br>U.S Army Engineer District, Omaha<br>1616 Capitol Avenue<br>Omaha, NE 68l02-4901 | 1 | 1 | 0 |
| Black Hills Area Office<br>Attn: CENWO-CDB<br>U.S. Army Corps of Engineers<br>631 St. Anne Street, Suite 101<br>Rapid City, SD 57701 | 2 | 2 | 1 |
| Ellsworth AFB Resident Office<br>Attn: CENWO-CDB-E (Matt Baird)<br>U.S. Army Corps of Engineers<br>2125 Scott Drive, Suite 1200<br>Ellsworth AFB, SD 57706-4711 | 1 | 1 | 1 |
| Omaha District Office<br>Attn: CENWO-CDS-C (Patricia Lambert)<br>U.S. Army Corps of Engineers<br>1616 Capitol Avenue<br>Omaha, NE 68l02-4901 | 1 | 0 | 0 |
| Ellsworth AFB Civil Engineering Squadron<br>Attn: 28th Civil Engineer Squadron (1LT Galbreath)<br>2125 Scott Drive<br>Ellsworth AFB, SD 57706 | 2 | 2 | 2 |
| Ellsworth AFB B-21 Program Integration Office<br>Attn: EAFB B-21 PIO (Erin Fletcher)<br>1947 Scott Drive<br>Ellsworth AFB, SD 57706 | 1 | 1 | 1 |
| AFCEC, San Antonio, TX<br>(specific address to be coordinated after contract award) | 1 | 0 | 0 |
| TOTAL COPIES: | 9<br>CD/DVD | 7<br>Half-size Drawings | 5<br>Full-size |

-- End of Section --

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28 CES AF FORM 103 BASE CIVIL ENGINEER WORK CLEARANCE OPERATING INSTRUCTION
BY ORDER OF THE 28 CES/CEO/CC
12 JUNE 2018
28TH CIVIL ENGINEER SQUADRON
SAFEGUARDING UTILITIES FROM DAMAGE
COMPLIANCE WITH THIS PUBLICATION IS MANDATORY
ACCESSIBILITY: Publication and forms are available at CEOER Shared Documents
RELEASABILITY: There are no releasability restrictions on this publication
OPR: 28 CES/CEOER
Certified by: 28 CES/CD (Mr. Glenn Meyer)
Supersedes: Same Publication, All Previous Dates
Pages: 1-5

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This instruction implements AFPD 32-10, *Installation and Facilities*, and establishes procedures to prevent damage to base utility systems, including water, sewer, drainage, pavements, fire alarms, electricity, natural gas, environmental systems and wells, and petroleum, oil, and lubricant (liquid fuel) and communications systems caused by other than enemy action, ravages, and fair wear, and places responsibility for such damage. It applies to all utility systems, regardless of the owner, within the geographical limits of Ellsworth AFB, and within areas where the 28th Mission Support Group (28 MSG) furnishes logistical support. This publication applies to any agency, governmental or private companies, that have to trench, excavate greater than four inches, hand dig, place an object into the ground, interrupt utilities, or accomplish work that will affect vehicular traffic flow. AF Form 103, *Base Civil Engineer Work Clearance,* is required for all aforementioned actions to coordinate work related activities with key base agencies and identify potentially hazardous work conditions. **Normally, routine work clearance requests will take <u>ten business days</u> to process** and is valid for the number of days indicated by the approving official. Failure to comply with this publication is punishable as a violation of Article 92, Uniform Code of Military Justice (UCMJ) and under all state and federal laws. The use of the name or mark of any specific manufacturer, commercial product, commodity, or service in this publication does not imply endorsement by the Air Force.

**Official records created or maintained as a result of this publication will be maintained in accordance with the applicable rule/disposition authority from Table 32-34, Utility Systems and Services, of the AFRIMS, Records Disposition Schedule (RDS) at: https://afrims.amc.af.mil**

**1. Responsibilities:**

1.1. All construction agencies will comply with this instruction.

1.2. All design and specification-preparing agencies will ensure all contractors are familiar with this instruction and its requirements. This instruction must be referenced in all design specifications, and a copy will be provided to the contractor during the pre-construction meeting.

1.3. The responsible utility system owner(s) will:

1.3.1. Conduct investigations into the circumstances surrounding the damage of its facility, as to time, cause, responsible person, agency or activity, and determine whether proper prior clearance has been obtained.

1.3.2. Determine method of repair and cost, if the government is responsible, for time and material for repairs.

1.3.3. Initiate action against appropriate agencies through the 28th Contracting Squadron (28 CS) for damage caused by individuals or agencies.

1.3.4. Initiate other action, as necessary, to minimize repetition or damage incident.

1.3.5. All utility agencies with utilities in the impacted area will locate their respective utility, regardless of the depth of excavation.

1.3.6. All utilities and excavation site will be marked according to the American Public Works Association uniform color codes (**ground-level utility flags or paint ONLY**):

| Marking Color | Description |
|---|---|
| **WHITE** | Proposed excavation |
| **PINK** | Temporary survey markings |
| **RED** | Electric power lines, cables, conduit, lighting cables |
| **YELLOW** | Gas, oil, steam, petroleum or gaseous materials |
| **ORANGE** | Communications, alarms or signal lines, cables or conduit, antenna satellite or CATV |
| **BLUE** | Potable water |
| **PURPLE** | Reclaimed water, irrigation, and slurry lines |
| **GREEN** | Sewers and drain lines |

1.3.7. When known, the total number of lines within the ground will be indicated. The number of lines indicated should be based on the physical lines. Multiple cables twisted together to form a single facility, as in the case of electric lines, would be considered one cable for locate purposes.

1.3.8. All agencies will notify the 28 CES Fire Department (28 CES/CEF), Hospital (ER) and 28th Security Forces on all road closures.

1.3.9. Notify the 28 CES/CEN GeoBase Section, 385-1346 or 385-6243, for the purpose of surveying/mapping of any exposed utility. Allow up to 72 hours for response to ensure proper coordination has occured.

1.4. To minimize damage to the utility and loss of service to customers, all digging within 2 feet of the marked utility will be performed by hand or with water/air vacuum equipment.

1.4.1. Some communications cables may require hand digging within 4 feet. This requirement will be at the discretion of the Commanders from either 28 CS or 28th Civil Engineer Squadron (28 CES), as appropriate.

1.4.2. With written approval, digging within 2 feet of a utility with equipment can be accomplished. This requirement will be at the discretion of the Commanders from either 28 CS or 28 CES, as appropriate.

1.4.3. **MDU** has specific safety requirements for excavations adjacent to natural gas pipeline, which can be found on **www.Montana-Dakota.com**.

1.5. Any damage to utilities will be the responsibility of the construction agency. Repairs to damaged utilities will commence within 2 hours, unless otherwise specified by the utility owner. Communication cable repairs will be performed by a licensed and certified technician, unless otherwise specified by the utility owner.

**NOTE: Damages need to be reported to 28 CES **immediately** to determine the isolation location.**

1.6. The 28 CES/CEF Fire Protection Flight Chief will coordinate on all construction activity involving disruption of utility services--especially water supply, fire alarms/suppression systems, and street closures.

****NOTE:** Disruption of water supply could be delayed during extremely dry climatic conditions, near open fields, forested areas, as directed by the Fire Protection Flight.**

1.7. All self-help work involving excavation, installation of TV/CB antennas, or any other work that may involve disruption of utilities requires the requester to have an approved Form 103, *Base Civil Engineer Work Clearance*. The form can be obtained from the 28 CES Customer Service Unit or the 28 CES/CEO front office located in building 8225.

**2. Procedures:**

2.1. The offices listed below will maintain copies of appropriate maps and drawings, delineating the utility system under their control, and are authorized to approve work to be done on, and adjacent to, the controlled utility system:

**2.1.1. Commander, 28th Communications Squadron (28 CS):** Communication cables, detection/alarm systems in airfield secure areas.

2.1.2. **Commander, 28th Civil Engineer Squadron (28 CES):** Water, sewer, drainage, pavements, natural gas, fire alarms, cathodic protection, environmental systems, and electricity (Montana-Dakota Utilities, Black Hills Power, Western Area Power Association, West River Electric Association.)

2.1.3. **Commander, 28 CES and Chief, Fuels Management Branch (28 LRS/LGRF):** Base liquid fuels system.

2.1.4. **Mid-Continent Commuications and Qwest Local Network:** Communication cables under their control.

2.1.5. **DGR Construction/Housing (Privatized Housing)**: All utilities under their control in accordance with the points of demarcation as outlined by the Ellsworth AFB map in the CES Asset Management Flight.

2.2. **Construction Agencies:** includes but not limited to 28 CS, 28 CES, U.S. Army Corps of Engineers, and contractors will maintain close liaison with offices mentioned in paragraph 1.1, this instruction, to ensure **NO EXCAVATION** is accomplished without prior coordination and approval.

2.3. The construction agent will present a plan of intended work, including work areas and description, to the appropriate and approval base agency for coordination. Coordination and approval must take place prior to commencing work, to minimize unnecessary damage to existing base utilities. Any project in which equipment penetrates or disturbs the ground, or any project in which digging will penetrate more than 4 inches into the ground, must be cleared in accordance with this instruction.

2.3.1. Any future changes to the scope will require a new clearance request. Digging outside of the defined work area is strictly prohibited.

2.3.2. If the work operation cannot be adequately described on AF Form 103, any construction agencies requesting clearance will schedule a meeting with each utility locate agency at the excavation site.

2.3.3. Construction agencies requesting clearance will be responsible for maintaining utility locates once they are initially marked by the utility agency. If markings are damaged or lost prior to digging operations, construction agencies must request new locates and will give the utility locating agency at least 48 hours to perform utility locates. Expenses for time and materials to accomplish repeat locates will be covered by the construction agency.

2.3.4. Construction agencies will be provided drawings depicting the locations of environmental systems as an attachment to the original work clearance request.

2.3.5. Construction agencies will be provided a 28 CES contact to call if additional information is required or if ground-level utility flags are missing.

2.3.6. Formal clearances will be approved by the Operations Flight's Commander, Deputy Operations Flight Commander, or the Operations Flight Chief on AF Form 103. Construction will be in accordance with AFI 32-1031, *Operations Management*. Clearance request is not valid until signed by the approving officer and **assigned a permit number**. The approving officer will not sign the request until all utilities are marked with a ground-level utility flag, and all utility agency signatures are on the clearance request.

2.3.6.1. Once completed and approved, the original work clearance request, with any applicable attachments, will be maintained on the job site by the requester during excavation and construction. A copy of the work clearance request will be maintained in the 28 CES/CEO offices for as long as deemed necessary.

2.3.7. The excavation work will commence within 14 days of being signed and approved; otherwise, clearance request is invalid and a new request is required

2.3.8. The completed work clearance request becomes invalid 30 days after signature. If work continues past 30 days, the work clearance request must be renewed by the approving official.

**3. Environmental Compliance:**

3.1. If contaminated soil or debris is encountered during excavation, stop work and immediately contact the Asset Management Flight, 28 CES/CEIE, at 385-2674. Any contaminated soil must be handled per 28 BW IEMP 10-2 Appendix 1. The construction agency is responsible for proper handling until laboratory analysis determines otherwise.

3.1.1. Immediately contact 28 CES/CEIE at 385- 2674, if an environmental ecosystem is harmed, a fossil or artifact is discovered, or if an endangered animal is discovered. For example, upon digging at a site, an artifact is uncovered or if an endangered animal is discovered on the site.

3.1.2. Prepare a Health and Safety Plan if working in an area with known contamination.

3.1.3. Do not use water from the shallow aquifer for any purpose including, but not limited to, drinking, irrigation, fire control, dust control, or any other activity.

3.1.4. Submit for approval to 28 CES/CEIE a report of engineering controls and methods designed to prevent cross contamination from the shallow aquifer to the confined aquifer prior to submitting a work clearance request to drill through the shallow aquifer.

3.1.5. Do not damage or interfere with access to and operation of any environmental system.

3.1.6. Return to 28 CES/CEIE a written certification of compliance with these land use controls no later than 30 days upon completion of any excavation or drilling.

3.2. The OPR for the AF Form 103, *Base Civil Engineer Work Clearance*, is the CES Customer Service Unit, CES/CEOER. Any updates or changes should be submitted to via email to svccall@us.af.mil or by calling 385-2580.

MEYER.GLENN.A.1231196443 Digitally signed by MEYER.GLENN.A.1231196443 Date: 2018.06.12 12:41:42 -06'00'

GLENN A. MEYER, GS-14, DAFC
Deputy Base Civil Engineer

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# BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST

*(See Instructions on Reverse)*

DATE PREPARED

1. Clearance is requested to proceed with work at _____

on Work Order No. _____, Contract No. _____, involving excavation or utility disturbance per attached sketch. This area ☐ has ☐ has not been staked or clearly marked.

2. TYPE OF FACILITY/WORK INVOLVED

| | | | | | |
|---|---|---|---|---|---|
| ☐ A. PAVEMENTS | ☐ D. FIRE DETECTION & PROTECTION SYSTEMS | | | | ☐ G. AIRCRAFT OR VEHICULAR TRAFFIC FLOW |
| ☐ B. DRAINAGE SYSTEMS | ☐ E. UTILITY | ☐ OVERHEAD | ☐ UNDERGROUND | | ☐ H. SECURITY |
| ☐ C. RAILROAD TRACKS | ☐ F. COMM | ☐ OVERHEAD | ☐ UNDERGROUND | | ☐ I. OTHER |

3. DATE CLEARANCE REQUIRED

4. DATE OF CLEARANCE

5. SIGNATURE OF REQUESTING OFFICIAL
Click to sign

6. TELEPHONE NO.

7. ORGANIZATION

| | ORGANIZATION | REMARKS *(Use Reverse for additional comments)* | REVIEWER'S NAME AND INITIALS |
|---|---|---|---|
| 8. BASE CIVIL ENGINEERING | A. ELECTRICAL DISTRIBUTION | To include Cathodic and WIMS cable:<br>Mr. Butler/Mr. Stolicker Bldg 8210 Ph.385-5538/5541 | Click to sign |
| | B. STEAM DISTRIBUTION | H/W & Chilled Water Lines & Ice Melt at 7502<br>Mr. Haakedahl/TSgt Smith, Bldg 8210, Ph:385-2503/2509 | Click to sign |
| | C. WATER DISTRIBUTION | 28 CES Utilities Shop<br>MSgt Walson/Mr. Tisdall Bldg 8210, Ph:385-5395 or 6309 | Click to sign |
| | D. POL DISTRIBUTION | Mr. LeBlanc<br>Bldg 8210, Ph: 385-2507 or 385-5402 | Click to sign |
| | E. SEWER DISTRIBUTION | 28 CES Utilities Shop<br>MSgt Walson/Mr. Tisdall Bldg 8210, Ph:385-5395 or 6309 | Click to sign |
| | F. ENVIRONMENTAL | 1. Compliance - Mr. Johnson, Bldg 8225 Ph: x2692<br>2. Restoration - Ms. Krebs/Mr. Christensen Ph: x2688/x6625 | Click to sign |
| | G. PAVEMENTS/ GROUNDS | Mr. Macy / Mr. Malone, Bldg 7612 Dock #52 Ph: 385-2209<br>This includes RIDS (R/W Ice Detection System) | Click to sign |
| | H. FIRE PROTECTION | Mr. Maxon Bldg 7502, Ph: 385-7306<br>Mr. Kmiotek, Fire Dept., Ph: 385-7305 | Click to sign |
| | I. ZONE Cass Shop | Bldg 8210 Ph: 385-5143<br>Mr. Haakedahl /TSgt Smith | Click to sign |
| | J. OTHER *(Specify)* Geo Base Irrigation (Grounds MXS) | Mr. Willis (CEN) Bldg: 8225 1st Floor; Ph: 385-6244<br>Mr. Crumley Bldg: 8225, Ph: 385-5826 *See back | Click to sign |
| 9. SECURITY POLICE | | SFS Desk 385-4001 (Resource Security office near south door) Bldg 4400 Mrs. Watson Ph: 385-2988 | Click to sign |
| 10. SAFETY | | Mr. Smartt / Mr. Walter, Base Ops.<br>Bldg 7501 Ph: 385-7233 | Click to sign |
| 11. COMMUNICATIONS | | Bldg 4307 Ph: 385-8353 | Click to sign |
| 12. BASE OPERATIONS | | MSgt Noel (If on Airfield, Call Before You Dig)<br>Airfield Ops, Bldg 7501 Ph: 385-1052 / 4275 / 1065 | Click to sign |
| 13. CABLE TV | | Mid-Continent Cable /Quest One Stop 1-800-781-7474<br>Confimation # | Click to sign |
| 14. COMMERCIAL UTILITY COMPANY<br>☒ TELEPHONE<br>☒ GAS<br>☒ ELECTRIC | | Telephone Systems O & M Contractor 385-1543 Bldg 4307<br><br>Natural Gas Mx<br>MSgt Walson/Mr. Tisdall Bldg 8210 Ph: 385-5395 or 6309 | Click to sign |

15. OTHER *(Specify)* MXS(if in airfield area)-LtC Wester, CMSgt Samavarchian, CMSgt Miller;bldg:7540 rm:127;Ph:385-5624/4212

16. REQUESTED CLEARANCE ☐ APPROVED ☐ DISAPPROVED

17. TYPED NAME AND SIGNATURE OF APPROVING OFFICER *(Chief of Operations Flight or Chief of Engineering Flight)*
Click to sign

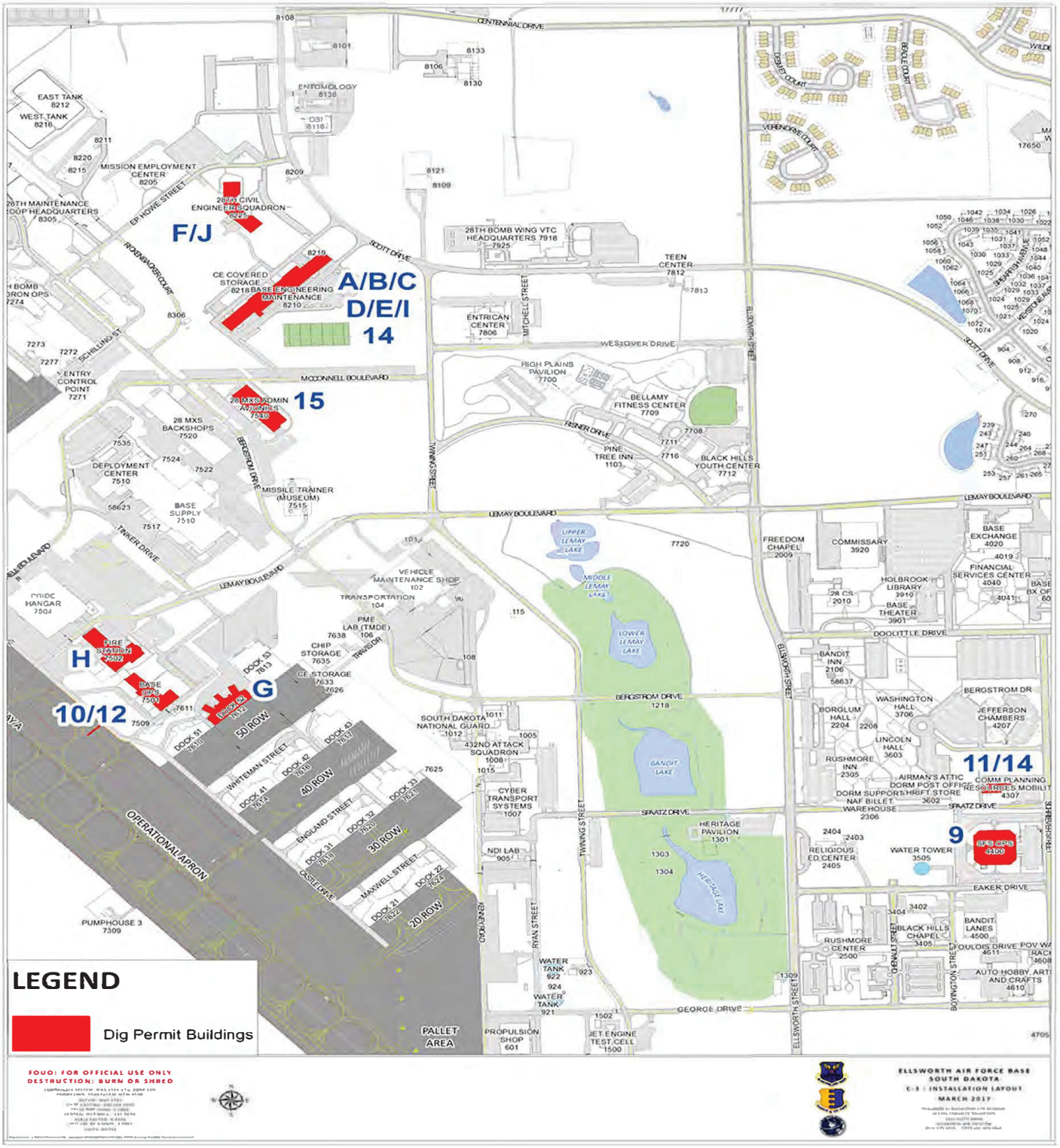
17a. DATE SIGNED

***INSTRUCTIONS***

*The BCE work clearance request is used for any work (contract or in-house) that may disrupt aircraft or vehicular traffic flow, base utility services, protection provided by fire and intrusion alarm system, or routine activities of the installation. This form is used to coordinate the required work with key base activities and keep customer inconvenience to a minimum. It is also used to identify potentially hazardous work conditions in an attempt to prevent accidents. The work clearance request is processed just prior to the start of work. If delays are encountered and the conditions at the job site change (or may have changed) this work clearance request must be reprocessed.*

18. REMARKS. *(This section must describe specific precautionary measure to be taken before and during work accomplishment. Specific comments concerning the approved method of excavation, hand or powered equipment, should be included.)*

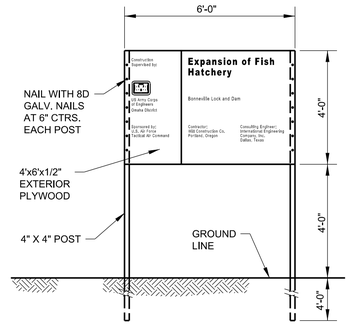
* 8J. Irrigation (Ground MXS): All irrigation/non-irrigation sites must be restored with Farm Deluxe Lawn Seed, weed/rock free.



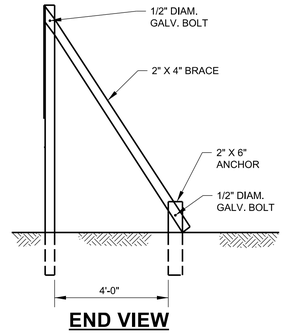
## MILCON PROJECT SIGN DETAILS

NOTES:

1. THE LARGE 4' X 4' SECTION OF THE PANEL ON THE RIGHT IS TO BE WHITE WITH BLACK LEGEND. THE 2' X 4' SECTION OF THE SIGN ON THE LEFT WITH THE FULL CORPS SIGNATURE (REVERSE VERSION) SHALL BE SCREEN-PRINTED COMMUNICATION WHITE ON THE RED BACKGROUND.
2. PROJECT TITLE LETTERS SHALL BE 3" HELVETICA BOLD. PROJECT LOCATION LETTERS SHALL BE 1.5" HELVETICA REGULAR. ALL OTHER LETTERS SHALL BE 1.25" HELVETICA REGULAR..
3. DECALCOMANIA FOR CORPS OF ENGINEERS SIGNATURE WILL BE FURNISHED BY THE CONTRACTING OFFICER FOR INSTALLATION BY THE CONTRACTOR.




**FRONT VIEW**




**END VIEW**

## SIGN FRAME DETAILS

NO SCALE

NOTES:

1. POSTS SHALL BE S4S.
2. PLYWOOD SHALL BE EXTERIOR TYPE, A-C GRADE.
3. BEFORE PAINTING, SURFACE SHALL BE CLEAN, DRY, FREE OF GREASE AND SANDED.
4. PAINT WITH ONE EXTERIOR OIL PRIME COAT AND EXTERIOR TYPE ALKYD, CONFORMING TO MASTER PAINTERS INSTITUTE MPI-9, MPI GLOSS LEVEL 6.

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

| MARK | DESCRIPTION | DATE | APPR |
|---|---|---|---|
| | | | |

| MARK | DESCRIPTION | DATE | APPR |
|---|---|---|---|
| | | | |

U. S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
OMAHA DISTRICT

DESIGNED BY: X
DWN BY: X
CKD BY: X
SUBMITTED BY: X
FILE NAME: auto_short_design
SIZE: 33.1X22
DATE:
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:
PLOT DATE: auto_sytime
PLOT SCALE: auto_scale

STANDARD DETAIL

PROJECT SIGN DETAILS
3/8" = 1'-0"

SHEET IDENTIFICATION NUMBER
C-8.2B

auto_design
auto_username

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SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 32 01.00 10

PROJECT SCHEDULE

**02/15**

PART 1 GENERAL

1.1 REFERENCES
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PROJECT SCHEDULE
**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.

AACE INTERNATIONAL (AACE)

| | |
|---|---|
| AACE 29R-03 | (2011) Forensic Schedule Analysis |
| AACE 52R-06 | (2006) Time Impact Analysis - As Applied in Construction |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| ER 1-1-11 | (2017) Administration -- Project Schedules |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation 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

Project Scheduler Qualifications; G, RO

Preliminary Project Schedule; G, RO

Initial Project Schedule; G, RO

Periodic Schedule Update; G, RO

1.3 PROJECT SCHEDULER QUALIFICATIONS

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating and production of reports. The authorized representative must have a minimum of 2-years experience scheduling construction projects similar in size and nature to this project with scheduling software that meets the requirements of this specification. Representative must have a comprehensive knowledge of CPM scheduling principles and application.

## PART 2 PRODUCTS

### 2.1 SOFTWARE

The scheduling software utilized to produce and update the schedules required herein must be capable of meeting all requirements of this specification.

#### 2.1.1 Government Default Software

The Government default software is Primavera P6.

#### 2.1.2 Contractor Software

Scheduling software used by the contractor must be commercially available from the software vendor for purchase with vendor software support agreements available. The software routine used to create the required sdef file must be created and supported by the software manufacturer.

##### 2.1.2.1 Primavera

If Primavera P6 is selected for use, provide the "xer" export file in a version of P6 importable by the Government system.

##### 2.1.2.2 Other Than Primavera

Use of software other than Primavera P6 must be approved by the Contracting Officer. If a different software system is approved, the Contracting Officer may require the Contractor to provide for the Government's use up to two licenses, two computers, and training for two Government employees in the use of the software. These computers will be stand-alone and not connected to Government network. Computers and licenses will be returned at project completion.

## PART 3 EXECUTION

### 3.1 GENERAL REQUIREMENTS

Prepare for approval a Project Schedule, as specified herein, pursuant to FAR Clause 52.236-15 Schedules for Construction Contracts. Show in the schedule the proposed sequence to perform the work and dates contemplated for starting and completing all schedule activities. The scheduling of the entire project is required. The scheduling of construction is the responsibility of the Contractor. Contractor management personnel must actively participate in its development. Subcontractors and suppliers working on the project must also contribute in developing and maintaining an accurate Project Schedule. Provide a schedule that is a forward planning as well as a project monitoring tool. Use the Critical Path Method (CPM) of network calculation to generate all Project Schedules. Prepare each Project Schedule using the Precedence Diagram Method (PDM).

### 3.2 BASIS FOR PAYMENT AND COST LOADING

The schedule is the basis for determining contract earnings during each update period and therefore the amount of each progress payment. The aggregate value of all activities coded to a contract CLIN must equal the value of the CLIN.

3.2.1 Activity Cost Loading

Activity cost loading must be reasonable and without front-end loading. Provide additional documentation to demonstrate reasonableness if requested by the Contracting Officer.

3.2.2 Withholdings / Payment Rejection

Failure to meet the requirements of this specification may result in the disapproval of the preliminary, initial or periodic schedule updates and subsequent rejection of payment requests until compliance is met.

In the event that the Contracting Officer directs schedule revisions and those revisions have not been included in subsequent Project Schedule revisions or updates, the Contracting Officer may withhold 10 percent of pay request amount from each payment period until such revisions to the project schedule have been made.

3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS

3.3.1 Level of Detail Required

Develop the Project Schedule to the appropriate level of detail to address major milestones and to allow for satisfactory project planning and execution. Failure to develop the Project Schedule to an appropriate level of detail will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.3.2 Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Less than 2 percent of all non-procurement activities may have Original Durations (OD) greater than 20 work days or 30 calendar days.

3.3.3 Procurement Activities

Include activities associated with the critical submittals and their approvals, procurement, fabrication, and delivery of long lead materials, equipment, fabricated assemblies, and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days.

3.3.4 Mandatory Tasks

Include the following activities/tasks in the initial project schedule and all updates.

a. Submission, review and acceptance of SD-01 Preconstruction Submittals (individual activity for each).

b. Submission, review and acceptance of features require design completion

c. Submission of mechanical/electrical/information systems layout drawings.

d. Long procurement activities

e. Submission and approval of O & M manuals.

f. Submission and approval of as-built drawings.

g. Submission and approval of DD1354 data and installed equipment lists.

h. Submission and approval of testing and air balance (TAB).

i. Submission of TAB specialist design review report.

j. Submission and approval of fire protection specialist.

k. Submission and approval of Building Commissioning Plan, test data, and reports: Develop the schedule logic associated with testing and commissioning of mechanical systems to a level of detail consistent with the contract commissioning requirements. All tasks associated with all building testing and commissioning will be completed prior to submission of building commissioning report and subsequent contract completion.

l. Air and water balancing.

m. Building commissioning - Functional Performance Testing.

n. Controls testing plan submission.

o. Controls testing.

p. Performance Verification testing.

q. Other systems testing, if required.

r. Contractor's pre-final inspection.

s. Correction of punch list from Contractor's pre-final inspection.

t. Government's pre-final inspection.

u. Correction of punch list from Government's pre-final inspection.

v. Final inspection.

3.3.5 Government Activities

Show Government and other agency activities that could impact progress. These activities include, but are not limited to: approvals, environmental permit approvals by State regulators, inspections, utility tie-in, Government Furnished Equipment (GFE) and Notice to Proceed (NTP) for phasing requirements.

3.3.6 Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11. This exact structure is mandatory. Develop and assign all Activity Codes to activities as detailed herein. A template SDEF compatible schedule backup file is available on the web site: http://rms.usace.army.mil.

The SDEF format is as follows:

| Field | Activity Code | Length | Description |
|---|---|---|---|
| 1 | WRKP | 3 | Workers per day |
| 2 | RESP | 4 | Responsible party |
| 3 | AREA | 4 | Area of work |
| 4 | MODF | 6 | Modification Number |
| 5 | BIDI | 6 | Bid Item (CLIN) |
| 6 | PHAS | 2 | Phase of work |
| 7 | CATW | 1 | Category of work |
| 8 | FOW | 20 | Feature of work* |

*Some systems require that FEATURE OF WORK values be placed in several activity code fields. The notation shown is for Primavera P6. Refer to the specific software guidelines with respect to the FEATURE OF WORK field requirements.

3.3.6.1 Workers Per Day (WRKP)

Assign Workers per Day for all field construction or direct work activities, unless directed otherwise by the Contracting Officer. Workers per day is based on the average number of workers expected each day to perform a task for the duration of that activity.

3.3.6.2 Responsible Party Coding (RESP)

Assign responsibility code for all activities to the Prime Contractor, Subcontractor(s) or Government agency(ies) responsible for performing the activity.

a. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Property/Equipment (GFP) and Notice to Proceed (NTP) for phasing requirements.

b. Activities cannot have more than one Responsibility Code. Examples of acceptable activity code values are: DOR (for the designer of record); ELEC (for the electrical subcontractor); MECH (for the mechanical subcontractor); and GOVT (for USACE).

3.3.6.3 Area of Work Coding (AREA)

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings.

Activities cannot have more than one Work Area Code.

Not all activities are required to be Work Area coded. A lack of Work Area coding indicates the activity is not resource or space constrained.

3.3.6.4 Modification Number (MODF)

Assign a Modification Number Code to any activity or sequence of activities added to the schedule as a result of a Contract Modification, when approved by Contracting Officer. Key all Code values to the Government's modification numbering system. An activity can have only one Modification Number Code.

3.3.6.5 Bid Item Coding (BIDI)

Assign a Bid Item Code to all activities using the Contract Line Item Schedule (CLIN) to which the activity belongs, even when an activity is not cost loaded. An activity can have only one BIDI Code.

3.3.6.6 Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities. Examples of phase of work are procurement phase and construction phase. Each activity can have only one Phase of Work code.

a. Code proposed fast track design and construction phases proposed to allow filtering and organizing the schedule by fast track design and construction packages.

b. If the contract specifies phasing with separately defined performance periods, identify a Phase Code to allow filtering and organizing the schedule accordingly.

3.3.6.7 Category of Work Coding (CATW)

Assign a Category of Work Code to all activities. Category of Work Codes include, but are not limited to construction submittal, procurement, fabrication, weather sensitive installation, non-weather sensitive installation, start-up, and testing activities. Each activity can have no more than one Category of Work Code.

3.3.6.8 Feature of Work Coding (FOW)

Assign a Feature of Work Code to appropriate activities based on the Definable Feature of Work to which the activity belongs based on the approved QC plan.

Definable Feature of Work is defined in Section 01 45 00.00 10 QUALITY CONTROL. An activity can have only one Feature of Work Code.

3.3.7 Contract Milestones and Constraints

Milestone activities are to be used for significant project events including, but not limited to, project phasing, project start and end activities, or interim completion dates. The use of artificial float constraints such as "zero free float" or "zero total float" are prohibited.

Mandatory constraints that ignore or effect network logic are prohibited.

No constrained dates are allowed in the schedule other than those specified herein. Submit additional constraints to the Contracting Officer for approval on a case by case basis.

3.3.7.1 Project Start Date Milestone and Constraint

The first activity in the project schedule must be a start milestone titled "NTP Acknowledged," which must have a "Start On" constraint date equal to the date that the NTP is acknowledged.

3.3.7.2 End Project Finish Milestone and Constraint

The last activity in the schedule must be a finish milestone titled "End Project."

Constrain the project schedule to the Contract Completion Date in such a way that if the schedule calculates an early finish, then the float calculation for "End Project" milestone reflects positive float on the longest path. If the project schedule calculates a late finish, then the "End Project" milestone float calculation reflects negative float on the longest path. The Government is under no obligation to accelerate Government activities to support a Contractor's early completion.

3.3.7.3 Interim Completion Dates and Constraints

Constrain contractually specified interim completion dates to show negative float when the calculated late finish date of the last activity in that phase is later than the specified interim completion date.

3.3.7.3.1 Start Phase

Use a start milestone as the first activity for a project phase. Call the start milestone "Start Phase X" where "X" refers to the phase of work.

3.3.7.3.2 End Phase

Use a finish milestone as the last activity for a project phase. Call the finish milestone "End Phase X" where "X" refers to the phase of work.

3.3.8 Calendars

Schedule activities on a Calendar to which the activity logically belongs. Develop calendars to accommodate any contract defined work period such as a 7-day calendar for Government Acceptance activities, concrete cure times, etc. Develop the default Calendar to match the physical work plan with non-work periods identified including weekends and holidays. Develop sSeasonal Calendar(s) and assign to seasonally affected activities as applicable.

If an activity is weather sensitive it should be assigned to a calendar showing non-work days on a monthly basis, with the non-work days selected at random across the weeks of the calendar, using the anticipated adverse weather delay work days provided in the Special Contract Requirements. Assign non-work days over a seven-day week as weather records are compiled on seven-day weeks, which may cause some of the weather related non-work days to fall on weekends.

3.3.9 Open Ended Logic

Only two open ended activities are allowed: the first activity "NTP Acknowledged" may have no predecessor logic, and the last activity -"End Project" may have no successor logic.

Predecessor open ended logic may be allowed in a time impact analyses upon the Contracting Officer's approval.

3.3.10 Default Progress Data Disallowed

Actual Start and Finish dates must not automatically update with default mechanisms included in the scheduling software. Updating of the percent complete and the remaining duration of any activity must be independent functions. Disable program features that calculate one of these parameters from the other. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process must match those dates provided in the Contractor Quality Control Reports. Failure to document the AS and AF dates in the Daily Quality Control report will result in disapproval of the Contractor's schedule.

3.3.11 Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Address out of sequence progress or logic changes in the Narrative Report and in the periodic schedule update meetings.

3.3.12 Added and Deleted Activities

Do not delete activities from the project schedule or add new activities to the schedule without approval from the Contracting Officer. Activity ID and description changes are considered new activities and cannot be changed without Contracting Officer approval.

3.3.13 Original Durations

Activity Original Durations (OD) must be reasonable to perform the work item. OD changes are prohibited unless justification is provided and approved by the Contracting Officer.

3.3.14 Leads, Lags, and Start to Finish Relationships

Lags must be reasonable as determined by the Government and not used in place of realistic original durations, must not be in place to artificially absorb float, or to replace proper schedule logic.

a. Leads (negative lags) are prohibited.

b. Start to Finish (SF) relationships are prohibited.

3.3.15 Retained Logic

Schedule calculations must retain the logic between predecessors and successors ("retained logic" mode) even when the successor activity(s) starts and the predecessor activity(s) has not finished (out-of-sequence

progress). Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") are not be allowed.

3.3.16 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete to allow for proper schedule management.

3.3.17 Remaining Duration

Update the remaining duration for each activity based on the number of estimated work days it will take to complete the activity. Remaining duration may not mathematically correlate with percentage found under paragraph entitled Percent Complete.

3.3.18 Cost Loading of Closeout Activities

Cost load the "Correction of punch list from Government pre-final inspection" activity(ies) not less than 1 percent of the present contract value. Activity(ies) may be declared 100 percent complete upon the Government's verification of completion and correction of all punch list work identified during Government pre-final inspection(s).

3.3.18.1 As-Built Drawings

If there is no separate contract line item (CLIN) for as-built drawings, cost load the "Submission and approval of as-built drawings" activity not less than $35,000 or 1 percent of the present contract value, whichever is greater, up to $200,000. Activity will be declared 100 percent complete upon the Government's approval.

3.3.18.2 O & M Manuals

Cost load the "Submission and approval of O & M manuals" activity not less than $20,000. Activity will be declared 100 percent complete upon the Government's approval of all O & M manuals.

3.3.19 Early Completion Schedule and the Right to Finish Early

An Early Completion Schedule is an Initial Project Schedule (IPS) that indicates all scope of the required contract work will be completed before the contractually required completion date.

a. No IPS indicating an Early Completion will be accepted without being fully resource-loaded (including crew sizes and manhours) and the Government agreeing that the schedule is reasonable and achievable.

b. The Government is under no obligation to accelerate work items it is responsible for to ensure that the early completion is met nor is it responsible to modify incremental funding (if applicable) for the project to meet the contractor's accelerated work.

## 3.4 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The files, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS. If the Contractor fails or refuses to furnish the information and schedule updates as set forth herein, then the Contractor will be deemed not to have provided an estimate upon which a progress payment can be made.

Review comments made by the Government on the schedule(s) do not relieve the Contractor from compliance with requirements of the Contract Documents.

### 3.4.1 Preliminary Project Schedule Submission

Within 15 calendar days after the NTP is acknowledged submit the Preliminary Project Schedule defining the planned operations detailed for the first 90 calendar days for approval. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the contract award CLINS shown on the Price Schedule. The Preliminary Project Schedule may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as specified. The Preliminary Project Schedule forms the basis for the Initial Project Schedule specified herein and must include all of the required plan and program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, planned submissions of all early design packages, permitting activities, design review conference activities, and other non-construction activities intended to occur within the first 90 calendar days. Government acceptance of the associated design package(s) and all other specified Program and Plan approvals must occur prior to any planned construction activities. Activity code any activities that are summary in nature after the first 90 calendar days with Bid Item (CLIN) code (BIDI), Responsibility Code (RESP) and Feature of Work code (FOW).

### 3.4.2 Initial Project Schedule Submission

Submit the Initial Project Schedule for approval within 42 calendar days after notice to proceed is issued. The schedule must demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. No payment will be made for work items not fully detailed in the Project Schedule.

### 3.4.3 Periodic Schedule Updates

Update the Project Schedule routinely at an interval approved by the Contracting Officer or designated representative. Provide a draft Periodic Schedule Update for review at the schedule update meetings as prescribed in the paragraph PERIODIC SCHEDULE UPDATE MEETINGS. These updates will enable the Government to assess Contractor's progress.

a. Update information including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete is subject to the approval of the Government at the meeting.

b. AS and AF dates must match the date(s) reported on the Contractor's Quality Control Report for an activity start or finish.

## 3.5 SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

### 3.5.1 Submission

Submit the current project schedule, the narrative report and all required schedule reports electronically using the project submittal/transmittal process or by serialized letter. Each schedule must have a unique file name and use project specific settings.

### 3.5.2 Narrative Report

Provide a Narrative Report with each schedule submission. The Narrative Report is expected to communicate to the Government the thorough analysis of the schedule output and the plans to compensate for any problems, either current or potential, which are revealed through that analysis. Include the following information as minimum in the Narrative Report:

a. Identify and discuss the work scheduled to start in the next update period.

b. A description of activities along the two most critical paths where the total float is less than or equal to 20 work days.

c. A description of current and anticipated problem areas or delaying factors and their impact and an explanation of corrective actions taken or required to be taken.

d. Identify and explain why activities based on their calculated late dates should have either started or finished during the update period but did not.

e. Identify and discuss all schedule changes by activity ID and activity name including what specifically was changed and why the change was needed. Include at a minimum new and deleted activities, logic changes, duration changes, calendar changes, lag changes, resource changes, and actual start and finish date changes.

f. Identify and discuss out-of-sequence work.

### 3.5.3 Schedule Reports

The format, filtering, organizing and sorting for each schedule report will be as directed by the Contracting Officer or designated representative. Typically, reports contain Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. Provide the reports electronically in .pdf format. The following reports are required for schedule submission reviews unless directed otherwise by the Contracting Officer.

#### 3.5.3.1 Activity Report

List of all activities sorted according to activity number.

3.5.3.2 Logic Report

List of detailed predecessor and successor activities for every activity in ascending order by activity number.

3.5.3.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.5.3.4 Earnings Report by CLIN

A compilation of the Total Earnings on the project from the NTP to the data date, which reflects the earnings of activities based on the agreements made in the schedule update meeting defined herein. Provided a complete schedule update has been furnished, this report serves as the basis of determining progress payments. Group activities by CLIN number and sort by activity number. Provide a total CLIN percent earned value, CLIN percent complete, and project percent complete. The printed report must contain the following for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Earnings to Date, Earnings this period, Total Quantity, Quantity to Date, and Percent Complete (based on cost).

3.5.3.5 Schedule Log

Provide a Scheduling/Leveling Report generated from the current project schedule being submitted.

3.5.3.6 Critical Path

Provide an Adobe .pdf report showing the critical path.

3.5.4 Network Diagram

The Network Diagram is required for the Preliminary, Initial and Periodic Updates. Depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.4.1 Continuous Flow

Show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

3.5.4.2 Project Milestone Dates

Show dates on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.4.3 Critical Path

Show all activities on the critical path. The critical path is defined as the longest path.

3.5.4.4 Banding

Organize activities using the WBS or as otherwise directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by major elements of work, category of work, work area and/or responsibility.

3.5.4.5 Cash Flow / Schedule Variance Control (SVC) Diagram

With each schedule submission, provide a SVC diagram showing 1) Cash Flow S-Curves indicating planned project cost based on projected early and late activity finish dates, and 2) Earned Value to-date.

3.6 PERIODIC SCHEDULE UPDATE

3.6.1 Periodic Schedule Update Meetings

Conduct periodic schedule update meetings for the purpose of reviewing the proposed percent complete, Periodic Schedule Update, Narrative Report, Schedule Reports, and progress payment. Conduct meetings at least monthly and within five days of the proposed schedule data date. The Contractor may be requested to provide a computer with the scheduling software loaded and a projector which allows all meeting participants to view the proposed schedule during the meeting. The Contractor's authorized scheduler must organize, group, sort, filter, perform schedule revisions as needed and review functions as requested by the Contractor and/or Government. The meeting is a working interactive exchange which allows the Government and Contractor the opportunity to review the updated schedule on a real time and interactive basis. The meeting will last no longer than 8 hours. The Contractor's Project Manager and scheduler must attend the meeting with the authorized representative of the Contracting Officer. Superintendents, foremen and major subcontractors must attend the meeting as required to discuss the project schedule and work. Following the periodic schedule update meeting, make updates to the draft submission. Include only those items approved by the Government in the submission. Upon Government approval of the schedule submission, submit an invoice for payment.

3.6.2 Update Submission Following Progress Meeting

Submit the complete Periodic Schedule Update of the Project Schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than 4 work days after the periodic schedule update meeting.

3.7 WEEKLY PROGRESS MEETINGS

Conduct a weekly meeting with the Government (or as otherwise mutually agreed to) between the meetings described in paragraph entitled PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. Use the current approved schedule update for the purposes of this meeting and for the production and review of reports. At the weekly progress meeting, address the status of RFIs, RFPs and Submittals.

3.8 REQUESTS FOR TIME EXTENSIONS

Provide a justification of delay to the Contracting Officer in accordance

with the contract provisions and clauses for approval within 10 days of a delay occurring. Also prepare a time impact analysis for each Government request for proposal (RFP)/ All time impact analysis must be resource loaded and to the same level of detail as the schedule.

3.8.1 Justification of Delay

Provide a description of the event(s) that caused the delay and/or impact to the work. As part of the description, identify all schedule activities impacted. Show that the event that caused the delay/impact was the responsibility of the Government. Provide a time impact analysis that demonstrates the effects of the delay or impact on the project completion date or interim completion date(s). Evaluate multiple impacts chronologically; each with its own justification of delay. With multiple impacts consider any concurrency of delay. A time extension and the schedule fragnet becomes part of the project schedule and all future schedule updates upon approval by the Contracting Officer.

3.8.2 Time Impact Analysis (Prospective Analysis)

Prepare a time impact analysis for approval by the Contracting Officer based on industry standard AACE 52R-06. Utilize a copy of the last approved schedule prior to the first day of the impact or delay for the time impact analysis. If Contracting Officer determines the time frame between the last approved schedule and the first day of impact is too great, prepare an interim updated schedule to perform the time impact analysis. Unless approved by the Contracting Officer, no other changes may be incorporated into the schedule being used to justify the time impact.

3.8.3 Forensic Schedule Analysis (Retrospective Analysis)

Prepare an analysis for approval by the Contracting Officer based on industry standard AACE 29R-03.

3.8.4 Fragmentary Network (Fragnet)

Prepare a proposed fragnet for time impact analysis consisting of a sequence of new activities that are proposed to be added to the project schedule to demonstrate the influence of the delay or impact to the project's contractual dates. Clearly show how the proposed fragnet is to be tied into the project schedule including all predecessors and successors to the fragnet activities. The proposed fragnet must be approved by the Contracting Officer prior to incorporation into the project schedule.

3.8.5 Time Extension

The Contracting Officer must approve the Justification of Delay including the time impact analysis before a time extension will be granted. No time extension will be granted unless the delay consumes all available Project Float and extends the projected finish date ("End Project" milestone) beyond the Contract Completion Date. The time extension will be in calendar days.

Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay will not be a cause for an extension to the performance period, completion date, or any interim milestone date.

### 3.8.6 Impact to Early Completion Schedule

No extended overhead will be paid for delay prior to the original Contract Completion Date for an Early Completion IPS unless the Contractor actually performed work in accordance with that Early Completion Schedule. The Contractor must show that an early completion was achievable had it not been for the impact.

## 3.9 FAILURE TO ACHIEVE PROGRESS

Should the progress fall behind the approved project schedule for reasons other than those that are excusable within the terms of the contract, the Contracting Officer may require provision of a written recovery plan for approval. The plan must detail how progress will be made-up to include which activities will be accelerated by adding additional crews, longer work hours, extra work days, etc.

### 3.9.1 Artificially Improving Progress

Artificially improving progress by means such as, but not limited to, revising the schedule logic, modifying or adding constraints, shortening activity durations, or changing calendars in the project schedule is prohibited. Indicate assumptions made and the basis for any logic, constraint, duration and calendar changes used in the creation of the recovery plan. Any additional resources, manpower, or daily and weekly work hour changes proposed in the recovery plan must be evident at the work site and documented in the daily report along with the Schedule Narrative Report.

### 3.9.2 Failure to Perform

Failure to perform work and maintain progress in accordance with the supplemental recovery plan may result in an interim and final unsatisfactory performance rating and may result in corrective action directed by the Contracting Officer pursuant to FAR 52.236-15 Schedules for Construction Contracts, FAR 52.249-10 Default (Fixed-Price Construction), and other contract provisions.

### 3.9.3 Recovery Schedule

Should the Contracting Officer find it necessary, submit a recovery schedule pursuant to FAR 52.236-15 Schedules for Construction Contracts.

## 3.10 OWNERSHIP OF FLOAT

Except for the provision given in the paragraph IMPACT TO EARLY COMPLETION SCHEDULE, float available in the schedule, at any time, may not be considered for the exclusive use of either the Government or the Contractor including activity and/or project float. Activity float is the number of work days that an activity can be delayed without causing a delay to the "End Project" finish milestone. Project float (if applicable) is the number of work days between the projected early finish and the contract completion date milestone.

## 3.11 TRANSFER OF SCHEDULE DATA INTO RMS

Once the schedule is approved by the Government via submittal or serialized letter, upload the schedule data (SDEF) into the Resident

Management System - Contractor Module (RMS CM) unless directed otherwise by the Contracting Officer. The contractor will then create the invoice and complete the Prompt Payment certificate and submit to the Government. After this is complete, create the invoice, complete the Prompt Payment certificate and submit to the Government. This data is considered to be additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 Payments under Fixed-Price Construction Contracts and FAR 52.232-27 Prompt Payment for Construction Contracts.

## 3.12 PRIMAVERA P6 MANDATORY REQUIREMENTS

The following settings are mandatory and required in all schedule submissions to the Government, if Primavera P6 is used:

a. Activity Codes must be Project Level, not Global or EPS level.

b. Calendars must be Project Level, not Global or Resource level.

c. Activity Duration Types must be set to "Fixed Duration & Units".

d. Percent Complete Types must be set to "Physical".

e. Time Period Admin Preferences must remain the default "8.0 hr/day, 40 hr/week, 172 hr/month, 2000 hr/year". Set Calendar Work Hours/Day to 8.0 Hour days.

f. Set Schedule Option for defining Critical Activities to "Longest Path".

g. Set Schedule Option for defining progressed activities to "Retained Logic".

h. Set up cost loading using a single lump sum labor resource. The Price/Unit must be $1/hr, Default Units/Time must be "8h/d", and settings "Auto Compute Actuals" and "Calculate costs from units" selected.

i. Activity ID's must not exceed 10 characters.

j. Activity Names must have the most defining and detailed description within the first 30 characters.

-- End of Section --

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**08/18, OMH 02/2021**

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SECTION 01 33 00

SUBMITTAL PROCEDURES
**08/18, OMH 02/2021**

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Submittal Information

The Contractor is responsible for total management of their work including, but not limited to, approval, scheduling, control, certification of all submittals and compliance with all applicable Buy-American and Trade Agreement clauses. The submittal management system provided in these specifications is intended to be a complete system for the Contractor to use to control the quality of materials, equipment and workmanship provided by manufacturers, fabricators, suppliers and subcontractors. Review each submittal for contract compliance. **Compliance with all applicable Buy American and Trade Agreement Clauses is to be included in this review. The Contractor must provide the country of origin on ENG Form 4025 for each item submitted.** The Submittal Register (ENG Form 4288) will be utilized to log and monitor all submittal activities.

The Contracting Officer may request submittals, in addition to those specified, when deemed necessary to adequately describe the work covered in the respective sections. Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

1.1.2 Project Type

The Contractor's Quality Control (CQC) System Manager is to check and approve all items before submittal and stamp, sign, and date indicating action taken. Clearly identify proposed deviations from the contract requirements. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required items.

1.1.3 Submission of Submittals

Schedule and provide submittals requiring Government approval, after notice to proceed (NTP). Provide ample lead time to ensure the submittal's processing by the Government and any lead time needed by the manufacturer upon ordering after approval. Dispose of samples not incorporated into the work in accordance with manufacturer's Safety Data Sheets (SDS) and in compliance with existing laws and regulations.

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 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.

The Government reserves the right to handle pre-construction submittals (listed below) as administrative submittals via a Serial Letter, as directed by the Project, Area or Resident Office. When directed by the Project, Area or Resident Office (as directed), submit administrative submittals for acceptance by the Government. Format for the Serial Letter will be as directed by the Project, Area or Resident Office.

Certificates Of Insurance

Surety Bonds

List Of Proposed Subcontractors

List Of Proposed Products

Baseline Network Analysis Schedule (NAS)

Submittal Register

Schedule Of Prices Or Earned Value Report

Accident Prevention Plan

Work Plan

Quality Control (QC) plan

Permits

Environmental Protection Plan

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" designation; submittals not having any designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with this section. When directed by the Government, the submittal register may be submitted via Section of 01 45 00.15 10 RESIDENTIAL MANAGMENT SYSTEM CONTRACTOR MODE (RMS-CM) in lieu of the copy attached to this section. SpecsIntact is the software system used by Government to generate the Submittal Register that is loaded into RMS-CM.

SD-01 Preconstruction Submittals

Submittal Register; G-RO

1.3.1 Action Codes

1.3.1.1 Contractor Action Codes

| DESIGN BID BUILD SUBMITTALS | | | |
|---|---|---|---|
| Submittal Classifications shown in UFGS Sections | Submittal Classification | Corresponding SpecsIntact Submittal Register Code which is populated in the SI Submittal Register. Software Limitations: (The software shows one character delineation in the SpecsIntact Submittal Register) | RMS – The following Submittal Classifications are populated in RMS when the SpecsIntact Submittal Data File is pulled into RMS) |
| G | Submittal requires Government Approval | G | GA |

| DESIGN BID BUILD SUBMITTALS | | | |
|---|---|---|---|
| BLANK | Submittal is For Information Only (FIO) | BLANK | FIO |

1.3.1.2 Government Reviewer Designations

Following the Submittal Classification designation "G", the following reviewer designations may be included:

RO - Resident Office
AO - Area Office
DO - District Office
AE - Architect Engineer

Additional information will be provided at the pre-design and/or pre-construction conference.

Corps of Engineers, Omaha District Office for "DO" reviewer designations, submittals will be coordinated through:

U.S. Army Corps of Engineers
Omaha District
Attn: CENWO-CDS-T
1616 Capitol Ave
Omaha, NE 68102-4901
E-mail: CENWO.ConstructionSubmittal@usace.army.mil

Architect Engineer (AE) reviewer designations, submittals will be coordinated through the Contracting Officer's Representative and the following AE:

Jacobs

1.4 SUBMITTAL CLASSIFICATION

1.4.1 Government Approved (G)

Government approval is required for extensions of design, critical materials, variations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Government.

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

Sustainability reporting submittals are as specified in Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

Schedule submittals for these items throughout the course of construction

as provided; do not wait until closeout.

## 1.5 PREPARATION

### 1.5.1 Transmittal Form

Use the ENG Form 4025 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 are included in the RMS CM software that the Contractor is required to use for this contract. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. If there are multiple Item numbers listed on a particular ENG Form 4025 submittal, combine all submitted items for review into a single Adobe file with bookmarks (for ease of review). 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.

### 1.5.2 Submittal Format

#### 1.5.2.1 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.

#### 1.5.2.2 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.

Submit an electronic copy of drawings in PDF format.

##### 1.5.2.2.1 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.

1.5.2.3 Format of SD-03 Product Data

Present product data submittals for each section. 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.

1.5.2.3.1 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.

1.5.2.3.2 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.

1.5.2.3.3 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.

1.5.2.4 Format of SD-04 Samples

1.5.2.4.1 Sample Characteristics

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.

1.5.2.4.2 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.

1.5.2.4.3 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.

1.5.2.5 Format of SD-05 Design Data

Provide design data and certificates on 8 1/2 by 11 inch page size.

1.5.2.6 Format of SD-06 Test Reports

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

1.5.2.7 Format of SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inch page size.

1.5.2.8 Format of SD-08 Manufacturer's Instructions

Present manufacturer's instructions submittals for each section. 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.

1.5.2.8.1 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.

1.5.2.9 Format of SD-09 Manufacturer's Field Reports

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

1.5.2.10 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.

1.5.2.11 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.

1.5.3 Source Drawings for Shop Drawings

1.5.3.1 Source Drawings

The entire set of source drawing files (DWG or DGN) 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.

1.5.3.2 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).

1.5.4 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. All documents must make use of optical character recognition (OCR) routines to make text searchable and selectable, so that the text can be copied. 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.

E-mail electronic submittal documents smaller than 10MB to an e-mail address as directed by the Contracting Officer, unless directed otherwise by COR. Provide electronic documents over 10 MB on an optical disc or through an electronic file sharing system, such as secure ftp site or DoD SAFE located at the following website: https://safe.apps.mil/. Use of the Government web application must be initiated by the Government, unless Contractor has a Government CAC card. This Government web application restricts the number of days files are available to download.

1.6 QUANTITY OF SUBMITTALS

Submittals are to be transmitted electronically, unless directed otherwise.

1.6.1 Number of SD-04 Samples

a. Submit two samples, or two sets of samples showing the range of variation, of each required item. One approved sample or set of samples will be retained by the approving authority and one will be returned to the Contractor.

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 INFORMATION ONLY SUBMITTALS

Submittals without an action code 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.

1.8 PROJECT SUBMITTAL REGISTER

A sample Project Submittal Register showing submittals required by the specifications is attached to this section as "Project Submittal Register."

1.8.1 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. Maintain a submittal register for the project in accordance with Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM). The Government will provide the initial submittal register in electronic format with the following fields completed, to the extent that will be required by the Government during subsequent usage.

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.

Thereafter, track all submittals by maintaining a complete list, including completion of all data columns and all dates on which submittals are received by and returned by the Government.

1.8.2 Preconstruction Use of Submittal Register

Submit the submittal register as an electronic database, using the submittal management program furnished to Contractor, unless directed otherwise by COR. 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.

1.8.3 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.

1.8.4 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.

1.8.5 Action Codes

See paragraph Action Codes above.

1.8.6 Delivery of Copies

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

1.9 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.

1.9.1 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. When contemplating a variation that results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

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

1.9.2 Proposing Variations

When proposing variations, deliver a written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

Check the column "variation" of ENG Form 4025 for submittals that include variations proposed by the Contractor. Set forth in writing the reason for any variations and note such variations on the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted variations.

1.9.3 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.

1.9.4 Review Schedule Extension

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

1.10 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.

Allow additional time for the review of the following submittals:

1. Site Security and Access Management Plan - extra 20 days.
2. Refrigeration and HVAC control systems - extra 20 days.
3. Fire alarm and fire suppression systems submittals - extra 20 days.
4. Security systems (IDS/ACS/CCTV) submittals - extra 20 days.
5. Electrical analysis studies (load flow, protective coordination, arc flash) - extra 20 days.
6. Panel and switchboard submittals - extra 20 days.

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.

Contracting Officer review will be completed within 20 calendar days after the date of submission except as noted above.

The Government review period for each construction submittal does not begin until the submittal is delivered via RMS CM. Contract compliance for all submittals are the Contractor's responsibility. Government acceptance or receipt acknowledged does not remove this responsibility for contract compliance on any construction submittal.

1.11 GOVERNMENT APPROVING AUTHORITY

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

a. Note the date on which the submittal was received.

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. An electronic copy of the submittal will be retained by the Contracting Officer and an electronic copy of the submittal will be returned to the Contractor. The Government may process submittals in the RMS CM System.

1.11.1 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.

1.12 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.

1.13 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 with in 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.

1.14 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not 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.

1.15 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained.

1.16 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 --

# SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

B-21: Weapons Loader Training (WLT) Facility, (FY23) - Ellsworth

CONTRACTOR

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| | | 01 14 00 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | Project Security And Site Access | 1.4 | G | RO | | | | | | | | | | | | | |
| | | | Management Plan | | | | | | | | | | | | | | | | |
| | | | CUI Training | 1.6.1 | G | RO | | | | | | | | | | | | | |
| | | 01 30 00.24 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | Contractor Trailer Area(s) | 1.25 | G | RO | | | | | | | | | | | | | |
| | | | Lay-Down Plan | | | | | | | | | | | | | | | | |
| | | | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Equipment Room Drawings | 1.23 | G | RO | | | | | | | | | | | | | |
| | | 01 32 01.00 10 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | Project Scheduler Qualifications | 1.3 | G | RO | | | | | | | | | | | | | |
| | | | Preliminary Project Schedule | 3.4.1 | G | RO | | | | | | | | | | | | | |
| | | | Initial Project Schedule | 3.4.2 | G | RO | | | | | | | | | | | | | |
| | | | Periodic Schedule Update | 3.6.2 | G | RO | | | | | | | | | | | | | |
| | | 01 33 00 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | Submittal Register | 1.8 | G | RO | | | | | | | | | | | | | |
| | | 01 33 29 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | Preliminary High Performance | 1.5.2.2 | G | | | | | | | | | | | | | | |
| | | | and Sustainable Building Checklist | | | | | | | | | | | | | | | | |
| | | | Sustainability Action Plan | 1.4.1 | G | | | | | | | | | | | | | | |
| | | | Preliminary Sustainability | 1.5.2.2 | G | | | | | | | | | | | | | | |
| | | | eNotebook | | | | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | | |
| | | | Final High Performance and | 1.5.2.2 | G | | | | | | | | | | | | | | |
| | | | Sustainable Building Checklist | | | | | | | | | | | | | | | | |
| | | | Final Sustainability eNotebook | 1.5.2.2 | G | | | | | | | | | | | | | | |

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| | | 01 33 29 | Amended Final Sustainability | 1.5.2.2 | G | | | | | | | | | | | | | |
| | | | eNotebook | | | | | | | | | | | | | | | |
| | | | Amended Final High | 1.5.2.2 | G | | | | | | | | | | | | | |
| | | | Performance and Sustainable | | | | | | | | | | | | | | | |
| | | | Building Checklist | | | | | | | | | | | | | | | |
| | | | Third Party Certification | 3.2 | G | | | | | | | | | | | | | |
| | | | Certificate, Assessment, or | | | | | | | | | | | | | | | |
| | | | Validation and Compliance Report | | | | | | | | | | | | | | | |
| | | 01 33 39.00 10 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Advanced Modeling Project | 1.4.1 | G DO | | | | | | | | | | | | | |
| | | | Execution Plan (PxP) | | | | | | | | | | | | | | | |
| | | | PxP Demonstration | 1.4.2 | | | | | | | | | | | | | | |
| | | 01 35 26 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | ACCIDENT PREVENTION PLAN | 1.7.1 | G RO | | | | | | | | | | | | | |
| | | | (APP) | | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
| | | | Monthly Exposure Reports | 1.4 | | | | | | | | | | | | | | |
| | | | Notifications and Reports | 1.12 | | | | | | | | | | | | | | |
| | | | Accident Reports | 1.12.2 | G RO | | | | | | | | | | | | | |
| | | | LHE Inspection Reports | 1.12.3 | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Crane Operators/Riggers | 1.6.1.4 | | | | | | | | | | | | | | |
| | | | Standard Lift Plan | 1.7.3.2 | G RO | | | | | | | | | | | | | |
| | | | Critical Lift Plan | 1.7.3.3 | G RO | | | | | | | | | | | | | |
| | | | Activity Hazard Analysis (AHA) | 1.8 | | | | | | | | | | | | | | |
| | | | Confined Space Entry Permit | 1.9.1 | | | | | | | | | | | | | | |

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| | | 01 35 26 | Hot Work Permit | 1.9.1 | | | | | | | | | | | | | | | |
| | | | Certificate of Compliance | 1.12.4 | | | | | | | | | | | | | | | |
| | | | License Certificates | 1.14 | | | | | | | | | | | | | | | |
| | | 01 41 26.01 24 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | Notice of Intent | 3.2.1 | | | | | | | | | | | | | | | |
| | | | Authorization Letter | 3.2.2 | | | | | | | | | | | | | | | |
| | | | Storm Water Pollution Prevention Plan | 3.2.4 | | | | | | | | | | | | | | | |
| | | | Notice of Termination | 3.2.7 | | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Reports | 3.2.5 | | | | | | | | | | | | | | | |
| | | 01 45 00.00 10 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | Contractor Quality Control (CQC) Plan | 3.2 | G | RO | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Verification Statement | 3.9 | | | | | | | | | | | | | | | |
| | | 01 45 35 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | SIOR Letter of Acceptance | 3.1.1 | G | RO | | | | | | | | | | | | | |
| | | | Project Manual | 3.1.1 | G | RO | | | | | | | | | | | | | |
| | | | Project Manual | 3.1.1 | G | RO | | | | | | | | | | | | | |
| | | | Written NDT Practices | 3.1.1 | | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Daily Reports | 3.1.1 | | | | | | | | | | | | | | | |
| | | | Daily Reports | 3.1.3 | | | | | | | | | | | | | | | |
| | | | Daily Reports | 3.1.3 | | | | | | | | | | | | | | | |
| | | | Biweekly Reports | 3.1.1 | | | | | | | | | | | | | | | |

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| | | 01 45 35 | Biweekly Reports | 3.1.2 | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | AISC Certified Steel Fabricator | 2.1 | | | | | | | | | | | | | | |
| | | | AC472 Accreditation | 2.1 | | | | | | | | | | | | | | |
| | | | Steel Joist Institute Membership | 2.1 | | | | | | | | | | | | | | |
| | | | Certificate of Compliance | 2.1 | | | | | | | | | | | | | | |
| | | | Special Inspector of Record | 1.5.14 | G | RO | | | | | | | | | | | | |
| | | | Special Inspector | 1.5 | G | RO | | | | | | | | | | | | |
| | | | Qualification Records | 3.1.1 | | | | | | | | | | | | | | |
| | | | Qualification Records | 3.1.3 | | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | Interim Report | 3.1.1 | G | RO | | | | | | | | | | | | |
| | | | Comprehensive Final Report | 3.1.1 | G | RO | | | | | | | | | | | | |
| | | | Comprehensive Final Report | 3.1.3 | G | RO | | | | | | | | | | | | |
| | | 01 57 19 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Environmental Protection Plan | 1.9 | G | RO | | | | | | | | | | | | |
| | | 01 74 19 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Construction Waste Management Plan | 1.7 | G | RO | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
| | | | Quarterly Reports | 1.9.2 | | | | | | | | | | | | | | |
| | | | Annual Report | 1.9.3 | | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | Final Construction Waste Diversion Report | 1.10 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | |

# SUBMITTAL REGISTER

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| | | 01 78 23 | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | |
| | | | Training Plan | 3.1.1 | G | RO | | | | | | | | | | | | |
| | | | Training Outline | 3.1.3 | G | RO | | | | | | | | | | | | |
| | | | Training Content | 3.1.2 | G | RO | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
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| | | | Facility Data Workbook, | 3.2 | G | RO | | | | | | | | | | | | |
| | | | Construction Final | | | | | | | | | | | | | | | |
| | | | Facility Document Set, | 1.6.3 | G | RO | | | | | | | | | | | | |
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| | | | Facility Document Set, | 3.2 | G | RO | | | | | | | | | | | | |
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| | | | 100 Percent Preliminary As-Built | 1.8.3 | G | DO | | | | | | | | | | | | |
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| | | | Steel Joist Framing | 1.3.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
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| | | | Design Calculations | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Erection Inspection | 3.4 | | | | | | | | | | | | | | | |
| | | | Welding Inspections | 3.4 | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Certification of Compliance | 1.3.2 | | | | | | | | | | | | | | | |
| | | 05 30 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Fabrication Drawings | 1.3.5 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Accessories | 2.2 | | | | | | | | | | | | | | | |
| | | | Deck Units | 2.1 | | | | | | | | | | | | | | | |
| | | | Galvanizing Repair Paint | 2.1.6 | | | | | | | | | | | | | | | |
| | | | Mechanical Fasteners | 2.2.17 | G | AE | | | | | | | | | | | | | |
| | | | Touch-Up Paint | 2.1.6 | | | | | | | | | | | | | | | |
| | | | Welding Equipment | 1.3.3 | | | | | | | | | | | | | | | |
| | | | Welding Rods and Accessories | 1.3.3 | | | | | | | | | | | | | | | |
| | | | Recycled Content of Steel Products | 2.1 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Metal Roof Deck Units | 2.1.1 | | | | | | | | | | | | | | | |
| | | | Flexible Closure Strips | 2.2.4 | | | | | | | | | | | | | | | |
| | | | SD-05 Design Data | | | | | | | | | | | | | | | | |
| | | | Deck Units | 2.1 | G | AE | | | | | | | | | | | | | |

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| | | 05 30 00 | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Powder-Actuated Tool Operator | 1.3.2 | | | | | | | | | | | | | | | |
| | | | Welder Qualifications | 1.3.3 | | | | | | | | | | | | | | | |
| | | | Welding Procedures | 1.3.3 | | | | | | | | | | | | | | | |
| | | | Fire Safety | 1.3.4.1 | | | | | | | | | | | | | | | |
| | | | Wind Storm Resistance | 1.3.4.2 | | | | | | | | | | | | | | | |
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| | | | Stud Manufacture's Certification | 2.2.12 | | | | | | | | | | | | | | | |
| | | | Stud Manufacture's Test Reports | 2.2.12 | | | | | | | | | | | | | | | |
| | | 05 40 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Framing Components | 1.6.1 | | G AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Studs, Joists | 2.1 | | | | | | | | | | | | | | | |
| | | | Recycled Content of Steel | 2.1 | | | | | | | | | | | | | | | |
| | | | Products | | | | | | | | | | | | | | | | |
| | | | SD-05 Design Data | | | | | | | | | | | | | | | | |
| | | | Metal Framing Calculations | 1.6.2 | | G AE | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Load-Bearing Cold-Formed Metal | 1.4 | | | | | | | | | | | | | | | |
| | | | Framing | | | | | | | | | | | | | | | | |
| | | | Welds | 3.1.1 | | | | | | | | | | | | | | | |
| | | 05 50 13 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Cover Plates and Frames | 2.5 | | G AE | | | | | | | | | | | | | |
| | | | Bollards/Pipe Guards | 2.6 | | G AE | | | | | | | | | | | | | |
| | | | Angles and Plates | 2.7 | | G AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |

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| | | 05 50 13 | Corner Guards | 2.4 | | | | | | | | | | | | | | | |
| | | | Cover Plates and Frames | 2.5 | G | AE | | | | | | | | | | | | | |
| | | | Recycled Content | 2.1 | | | | | | | | | | | | | | | |
| | | 05 51 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Iron and Steel Hardware | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Steel Shapes, Plates, Bars, and Strips | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Metal Stair System | 2.2.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Structural Steel Plates, Shapes, and Bars | 2.4.1 | G | AE | | | | | | | | | | | | | |
| | | | Structural Steel Tubing | 2.4.2 | G | AE | | | | | | | | | | | | | |
| | | | Hot-Rolled Carbon Steel Sheets and Strips | 2.4.5 | G | AE | | | | | | | | | | | | | |
| | | | Cold-Finished Steel Bars | 2.4.4 | G | AE | | | | | | | | | | | | | |
| | | | Hot-Rolled Carbon Steel Bars | 2.4.3 | G | AE | | | | | | | | | | | | | |
| | | | Cold-Rolled Carbon Steel Sheets | 2.4.6 | G | AE | | | | | | | | | | | | | |
| | | | Concrete Inserts | 2.3.2 | G | AE | | | | | | | | | | | | | |
| | | | Protective Coating | 2.2.4 | G | AE | | | | | | | | | | | | | |
| | | | Steel Pan Stairs | 2.2.2 | G | AE | | | | | | | | | | | | | |
| | | | Steel Stairs | 2.3.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Welding Procedures | 1.3.1 | G | RO | | | | | | | | | | | | | |
| | | | Welder Qualification | 1.3.1 | G | RO | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | | |
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| | | 05 51 00 | Structural Steel Plates, Shapes, and Bars | 2.4.1 | G | RO | | | | | | | | | | | | | |
| | | | Structural Steel Tubing | 2.4.2 | G | RO | | | | | | | | | | | | | |
| | | | Hot-Rolled Carbon Steel Sheets and Strips | 2.4.5 | G | RO | | | | | | | | | | | | | |
| | | | Cold-Finished Steel Bars | 2.4.4 | G | RO | | | | | | | | | | | | | |
| | | | Hot-Rolled Carbon Steel Bars | 2.4.3 | G | RO | | | | | | | | | | | | | |
| | | | Cold-Rolled Carbon Steel Sheets | 2.4.6 | G | RO | | | | | | | | | | | | | |
| | | | Protective Coating | 2.2.4 | G | RO | | | | | | | | | | | | | |
| | | 05 51 33 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Ladders | 2.3 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Ladders | 2.3 | G | AE | | | | | | | | | | | | | |
| | | | Ladder Safety Devices | 2.3.2 | G | AE | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Fabricator Certification for Ladder Assembly | 1.3 | | | | | | | | | | | | | | | |
| | | | Fabricator Certification for Ships Ladder Assembly | 1.3 | | | | | | | | | | | | | | | |
| | | 05 52 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Fabrication Drawings | 1.2.1 | G | AE | | | | | | | | | | | | | |
| | | | Iron and Steel Hardware | 3.2 | G | AE | | | | | | | | | | | | | |
| | | | Steel Shapes, Plates, Bars and Strips | 3.2 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
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| | | 05 52 00 | Structural-Steel Plates, Shapes, | 2.2.1 | G | AE | | | | | | | | | | | | |
| | | | and Bars | | | | | | | | | | | | | | | |
| | | | Structural-Steel Tubing | 2.2.2 | G | AE | | | | | | | | | | | | |
| | | | Cold-Finished Steel Bars | 2.2.4 | G | AE | | | | | | | | | | | | |
| | | | Hot-Rolled Carbon Steel Bars | 2.2.3 | G | AE | | | | | | | | | | | | |
| | | | Concrete Inserts | 2.2.6 | G | AE | | | | | | | | | | | | |
| | | | Protective Coating | 2.1.2 | G | AE | | | | | | | | | | | | |
| | | | Steel Railings and Handrails | 2.2.8 | G | AE | | | | | | | | | | | | |
| | | | Anchorage and Fastening | 1.2.1 | G | AE | | | | | | | | | | | | |
| | | | Systems | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Welding Procedures | 1.4.1 | G | RO | | | | | | | | | | | | |
| | | | Welder Qualification | 1.4.2 | G | RO | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | |
| | | | Installation Instructions | 3.2 | | | | | | | | | | | | | | |
| | | 06 10 00 | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Fire-retardant Treatment | 1.7 | G | AE | | | | | | | | | | | | |
| | | | Adhesives | 2.3.2 | G | AE | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Certificates of Grade | 1.9.1 | G | RO | | | | | | | | | | | | |
| | | | Certified Sustainably Harvested | 2.1.1 | | | | | | | | | | | | | | |
| | | | Virgin Lumber | | | | | | | | | | | | | | | |
| | | | Certified Sustainably Harvested | 2.2.1.1 | | | | | | | | | | | | | | |
| | | | Plywood for Other Uses | | | | | | | | | | | | | | | |
| | | 06 41 16.00 10 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Shop Drawings | 2.8 | G | AE | | | | | | | | | | | | |

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| | | 06 41 16.00 10 | Installation | 3.1 | | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Wood Materials | 2.1 | | | | | | | | | | | | | | | |
| | | | Finish Schedule | 2.8.7.3 | | | | | | | | | | | | | | | |
| | | | Certification | 1.5.2 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Plastic Laminates | 2.3 | G | AE | | | | | | | | | | | | | |
| | | | Cabinet Hardware | 2.5 | G | AE | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Quality Assurance | 1.5 | | | | | | | | | | | | | | | |
| | | | Laminate Clad Casework | 3.1 | | | | | | | | | | | | | | | |
| | | 06 61 16 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Detail Fabrication Drawings | 1.4.2 | G | AE | | | | | | | | | | | | | |
| | | | Installation | 3.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Solid Polymer | 2.1.1 | G | AE | | | | | | | | | | | | | |
| | | | Indoor air quality for solid surface | 2.2.2 | | | | | | | | | | | | | | | |
| | | | seam and sealant products | | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Material | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Counter Tops | 2.3.4 | G | AE | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Test Report Results | 2.1.1 | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Qualifications | 1.4.1 | | | | | | | | | | | | | | | |
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| | | 06 61 16 | Indoor Air Quality for solid | 2.1.1 | | | | | | | | | | | | | | |
| | | | surface fabrication products | | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | |
| | | | Solid Polymer | 2.1.1 | G | RO | | | | | | | | | | | | |
| | | 07 21 16 | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Sound-Attenuation Blanket | 2.1 | G | AE | | | | | | | | | | | | |
| | | | Insulation | | | | | | | | | | | | | | | |
| | | | Recycled Content for Insulation | 2.1.1 | | | | | | | | | | | | | | |
| | | | Materials | | | | | | | | | | | | | | | |
| | | | Sill Sealer Insulation | 2.2 | G | AE | | | | | | | | | | | | |
| | | | Accessories | 2.4 | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Indoor Air Quality for Insulation | 2.1.3 | | | | | | | | | | | | | | |
| | | | Materials | | | | | | | | | | | | | | | |
| | | | Indoor Air Quality for Adhesives | 2.4.1 | | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | |
| | | | Insulation | 3.3.1 | | | | | | | | | | | | | | |
| | | 07 27 36 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Qualification of Manufacturer | 1.8.1 | G | RO | | | | | | | | | | | | |
| | | | Qualification of Installer | 1.8.2 | G | RO | | | | | | | | | | | | |
| | | | Quality Control Plan | 1.9 | G | RO | | | | | | | | | | | | |
| | | | Safety Plan | 1.9 | G | RO | | | | | | | | | | | | |
| | | | Fire Prevention Plan | 1.7.1 | G | RO | | | | | | | | | | | | |
| | | | Respirator Plan | 1.7.2 | G | RO | | | | | | | | | | | | |
| | | | SD-02 Shop Drawings | | | | | | | | | | | | | | | |

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| | | 07 27 36 | Spray Foam Air Barrier | 1.4 | | | | | | | | | | | | | | | |
| | | | Foam Air Barrier System | 1.9 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Open Cell | 2.1.2 | G | AE | | | | | | | | | | | | | |
| | | | Primers, Adhesives, and Mastics | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | Sealants | 2.3 | G | AE | | | | | | | | | | | | | |
| | | | Safety Data Sheets | 1.4.2 | G | AE | | | | | | | | | | | | | |
| | | | Thermal Barrier Materials | 2.1.1 | G | AE | | | | | | | | | | | | | |
| | | | Recycled Content for Open Cell Spray Foam Air Barrier | 2.1.2 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Spray Foam Air Barrier | 1.4 | G | RO | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Field Peel Adhesion Test | 1.4.4 | G | RO | | | | | | | | | | | | | |
| | | | Primers | 1.4.3 | G | RO | | | | | | | | | | | | | |
| | | | Fire-Ratings Of Thermal Barrier Materials | 1.4.4 | G | RO | | | | | | | | | | | | | |
| | | | Flame Spread And Smoke Developed Index Ratings Of SPF Products | 1.4.4 | G | RO | | | | | | | | | | | | | |
| | | | Flame Propagation Of Wall Assemblies | 1.4.4 | G | RO | | | | | | | | | | | | | |
| | | | Site Inspections | 3.4.1 | G | RO | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Open cell | 2.1.2 | G | RO | | | | | | | | | | | | | |
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| | | | SD-08 Manufacturer's Instructions | | | | | | | | | | | | | | | |
| | | | SPF Handling, Storage, and | 1.5.1 | G | RO | | | | | | | | | | | | |
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| | | | Substrate Preparation | 3.2.1 | G | RO | | | | | | | | | | | | |
| | | | Thermal Barrier | 1.4.1 | G | RO | | | | | | | | | | | | |
| | | | Primers, Adhesives, and Mastics | 2.2 | G | RO | | | | | | | | | | | | |
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| | | | Reports | | | | | | | | | | | | | | | |
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| | | | Qualification of Installation | 1.5.4 | G | RO | | | | | | | | | | | | |
| | | | Contractor | | | | | | | | | | | | | | | |
| | | | Warranty | 1.8 | G | RO | | | | | | | | | | | | |
| | | | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Installation Drawings | 1.5.1.1 | G | AE | | | | | | | | | | | | |
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| | | | Factory Color Finish | 2.2.2 | | | | | | | | | | | | | | |
| | | | Closure Materials | 1.5.5 | | | | | | | | | | | | | | |
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| | | 07 42 13 | Galvanizing Repair Paint | 1.5.3.1 | | | | | | | | | | | | | | | |
| | | | Enamel Repair Paint | 1.5.3.1 | | | | | | | | | | | | | | | |
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| | | | Wind load design analysis | 1.5.1.2 | G | AE | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Leakage Tests | 3.7.2 | G | RO | | | | | | | | | | | | | |
| | | | Wind Load Tests | 1.3.2 | G | RO | | | | | | | | | | | | | |
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| | | | Chalking | 2.2.2.6 | G | RO | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Coil Stock | 1.5.3.1 | G | RO | | | | | | | | | | | | | |
| | | | Fasteners | 1.5.3.1 | G | RO | | | | | | | | | | | | | |
| | | | Enamel Repair Paint | 1.5.3.1 | G | RO | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | | |
| | | | Installation | 3.3 | G | RO | | | | | | | | | | | | | |
| | | | SD-09 Manufacturer’s Field | | | | | | | | | | | | | | | | |
| | | | Reports | | | | | | | | | | | | | | | | |
| | | | Manufacturer's Field Reports | 3.8.1 | G | RO | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | | |

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| | | 07 42 13 | Warranty | 1.8 | G | RO | | | | | | | | | | | | | |
| | | | Maintenance Instructions | 1.5.6 | G | RO | | | | | | | | | | | | | |
| | | | 20 year 'No Dollar Limit' warranty | 1.8.1 | | | | | | | | | | | | | | | |
| | | | for labor and material | | | | | | | | | | | | | | | | |
| | | 07 84 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Firestopping System | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Firestopping Materials | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Inspection | 3.3 | G | RO | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Inspector Qualifications | 1.5.2 | | | | | | | | | | | | | | | |
| | | | Firestopping Materials | 2.2 | | | | | | | | | | | | | | | |
| | | | Installer Qualifications | 1.5.1 | G | RO | | | | | | | | | | | | | |
| | | 07 92 00 | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Sealants | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Primers | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | Bond Breakers | 2.3 | G | AE | | | | | | | | | | | | | |
| | | | Backstops | 2.4 | G | AE | | | | | | | | | | | | | |
| | | | Field Adhesion | 3.1 | G | RO | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Indoor Air Quality For Interior | 2.1.1 | | | | | | | | | | | | | | | |
| | | | Sealants | | | | | | | | | | | | | | | | |
| | | | Indoor Air Quality For Interior | 2.1.3 | | | | | | | | | | | | | | | |
| | | | Floor Joint Sealants | | | | | | | | | | | | | | | | |
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| | | 07 92 00 | Indoor Air Quality For Interior | 2.1.4 | | | | | | | | | | | | | | | |
| | | | Acoustical Sealants | | | | | | | | | | | | | | | | |
| | | 08 11 13 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Doors | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Doors | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Frames | 2.5 | G | AE | | | | | | | | | | | | | |
| | | | Frames | 2.5 | G | AE | | | | | | | | | | | | | |
| | | | Accessories | 2.3 | | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Doors | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Recycled Content for Steel Door | 2.1 | | | | | | | | | | | | | | | |
| | | | Product | | | | | | | | | | | | | | | | |
| | | | Frames | 2.5 | G | AE | | | | | | | | | | | | | |
| | | | Recycled Content for Steel Frame | 2.5 | | | | | | | | | | | | | | | |
| | | | Product | | | | | | | | | | | | | | | | |
| | | | Accessories | 2.3 | | | | | | | | | | | | | | | |
| | | 08 11 16 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Door and Frame Assembly | 1.5.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Door and Frame Assembly | 1.5.1 | G | AE | | | | | | | | | | | | | |
| | | | Recycled Content of Aluminum | 2.2.3 | | | | | | | | | | | | | | | |
| | | | Material | | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Finish Samples | 1.5.2 | G | AE | | | | | | | | | | | | | |
| | | | Air Infiltration | 1.2.1 | G | RO | | | | | | | | | | | | | |
| | | | Water Penetration | 1.2.2 | G | RO | | | | | | | | | | | | | |

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| | | 08 11 16 | NFRC Project Label Certificates | 1.2.3 | G | RO | | | | | | | | | | | | | |
| | | | for Fenestration | | | | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer's Instructions | | | | | | | | | | | | | | | | |
| | | | Door and Frame Assembly | 1.5.1 | G | RO | | | | | | | | | | | | | |
| | | | Adjustments, Cleaning, and | 1.5.3 | G | RO | | | | | | | | | | | | | |
| | | | Maintenance | | | | | | | | | | | | | | | | |
| | | | NFRC Project Label Certificates | 1.2.3 | G | RO | | | | | | | | | | | | | |
| | | | for Fenestration | | | | | | | | | | | | | | | | |
| | | 08 14 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Doors | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Doors | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Recycled Content for Door Cores | 2.1.1.1 | | | | | | | | | | | | | | | |
| | | | Accessories | 2.2 | | | | | | | | | | | | | | | |
| | | | Warranty | 1.5 | | | | | | | | | | | | | | | |
| | | | Sound Transmission Class | 2.1.2 | G | AE_ | | | | | | | | | | | | | |
| | | | Rating | | | | | | | | | | | | | | | | |
| | | | Fire Resistance Rating | 2.1.3 | G | AE | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Doors | 2.1 | | | | | | | | | | | | | | | |
| | | | Door Finish Colors | 2.3.6.2 | G | AE | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Cycle-Slam | 2.4 | | | | | | | | | | | | | | | |
| | | | Hinge Loading Resistance | 2.4 | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Certificates of Grade | 1.3.1 | | | | | | | | | | | | | | | |

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| | | 08 14 00 | Certified Sustainably Harvested | 2.1.1 | | | | | | | | | | | | | | |
| | | | Flush Wood Doors | | | | | | | | | | | | | | | |
| | | | Indoor Air Quality for | 2.1.1.1 | | | | | | | | | | | | | | |
| | | | Particleboard and Agrifiber Door | | | | | | | | | | | | | | | |
| | | | Cores | | | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | Warranty | 1.5 | | | | | | | | | | | | | | |
| | | 08 31 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Access Doors And Panels | 1.3 | G | AE | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Access Doors And Panels | 1.3 | G | AE | | | | | | | | | | | | |
| | | | Hardware | 1.3.2 | G | AE | | | | | | | | | | | | |
| | | | Accessories | 2.2.8 | G | AE | | | | | | | | | | | | |
| | | | Recycled Content | 2.1 | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | |
| | | | Finishes | 2.5 | G | AE | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
| | | | Fire-rating(s) of Assemblies | 1.3.1 | G | RO | | | | | | | | | | | | |
| | | | Acoustical Ratings of Assemblies | 1.3.1 | G | RO | | | | | | | | | | | | |
| | | 08 33 23 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Overhead Coiling Doors | 2.2.1 | G | AE | | | | | | | | | | | | |
| | | | Counterbalancing Mechanism | 2.2.3 | G | AE | | | | | | | | | | | | |
| | | | Manual Door Operators | 2.2.4 | G | AE | | | | | | | | | | | | |
| | | | Electric Door Operators | 2.2.5 | G | AE | | | | | | | | | | | | |
| | | | Bottom Bars | 2.2.1.4 | G | AE | | | | | | | | | | | | |
| | | | Guides | 2.1.1.1 | G | AE | | | | | | | | | | | | |

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| | | 08 33 23 | Mounting Brackets | 2.2.3.1 | G | AE | | | | | | | | | | | | | |
| | | | Hood | 2.2.2.2 | G | AE | | | | | | | | | | | | | |
| | | | Installation Drawings | 2.1.1.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Overhead Coiling Doors | 2.2.1 | G | AE | | | | | | | | | | | | | |
| | | | Hardware | 2.2.2 | G | AE | | | | | | | | | | | | | |
| | | | Counterbalancing Mechanism | 2.2.3 | G | AE | | | | | | | | | | | | | |
| | | | Manual Door Operators | 2.2.4 | G | AE | | | | | | | | | | | | | |
| | | | Electric Door Operators | 2.2.5 | G | AE | | | | | | | | | | | | | |
| | | | Fire-Rated Door Assembly | 2.2.6 | G | AE | | | | | | | | | | | | | |
| | | | Recycled content for steel curtain slats | 2.2.1.1 | | | | | | | | | | | | | | | |
| | | | SD-05 Design Data | | | | | | | | | | | | | | | | |
| | | | Overhead Coiling Doors | 2.2.1 | G | AE | | | | | | | | | | | | | |
| | | | Hardware | 2.2.2 | G | AE | | | | | | | | | | | | | |
| | | | Counterbalancing Mechanism | 2.2.3 | G | AE | | | | | | | | | | | | | |
| | | | Manual Door Operators | 2.2.4 | G | AE | | | | | | | | | | | | | |
| | | | Electric Door Operators | 2.2.5 | G | AE | | | | | | | | | | | | | |
| | | | Fire-Rated Door | 1.3 | G | AE | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance Data | | | | | | | | | | | | | | | | |
| | | | Operation and Maintenance Manuals | 1.3.2 | G | RO | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | | |
| | | | Warranty | 1.3.1 | G | RO | | | | | | | | | | | | | |
| | | 08 34 73 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |

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| | | 08 34 73 | Fabrication Drawings | 2.1 | | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Hollow Metal Sound Retardant | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Doors | | | | | | | | | | | | | | | | |
| | | | Wood Sound Retardant Doors | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Door Frames | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Door Hardware | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Door Frame Sound Infill | 2.3.2 | G | AE | | | | | | | | | | | | | |
| | | | Intumescent Seals and Gasketing | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Thresholds | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Astragals | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Wind Loading Tests | 2.4.4 | G | RO | | | | | | | | | | | | | |
| | | | Water Leakage Tests | 2.4.4 | G | RO | | | | | | | | | | | | | |
| | | | Acoustical Tests | 2.4.4 | G | RO | | | | | | | | | | | | | |
| | | | Air Infiltration Tests | 2.4.4 | G | RO | | | | | | | | | | | | | |
| | | | Positive Pressure Tests | 2.4.4 | G | RO | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Hollow Metal Sound Retardant | 2.1 | G | RO | | | | | | | | | | | | | |
| | | | Doors | | | | | | | | | | | | | | | | |
| | | | Wood Sound Retardant Doors | 2.1 | G | RO | | | | | | | | | | | | | |
| | | | Door Frames | 2.1 | G | RO | | | | | | | | | | | | | |
| | | | Door Hardware | 2.1 | G | RO | | | | | | | | | | | | | |
| | | | Intumescent Seals,Gasketing and | 1.3.1.3 | G | RO | | | | | | | | | | | | | |
| | | | Door Bottoms | | | | | | | | | | | | | | | | |
| | | | Thresholds | 2.1 | G | RO | | | | | | | | | | | | | |

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| | | 08 34 73 | Astragals | 2.1 | G | RO | | | | | | | | | | | | | |
| | | | Assembly Test Reports | 3.3.1 | | | | | | | | | | | | | | | |
| | | 08 41 13 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | Sample Warranty | 1.2.1 | G | RO | | | | | | | | | | | | | |
| | | | List of Product Installations | 1.2.1 | G | RO | | | | | | | | | | | | | |
| | | | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Installation Drawings | 3.3 | G | AE | | | | | | | | | | | | | |
| | | | Fabrication Drawings | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Manufacturer's Catalog Data | 1.2.1 | G | AE | | | | | | | | | | | | | |
| | | | Finish | 2.2.3 | G | AE | | | | | | | | | | | | | |
| | | | Recycled Content of Aluminum | 2.1.1.2 | | | | | | | | | | | | | | | |
| | | | Material | | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Finish and Color Samples | 1.2.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Certified Test Reports | 1.2.1 | G | RO | | | | | | | | | | | | | |
| | | | Deflection | 3.4.3 | | | | | | | | | | | | | | | |
| | | | Air Infiltration | 3.4.1 | | | | | | | | | | | | | | | |
| | | | Condensation Resistance and | 3.4.4 | | | | | | | | | | | | | | | |
| | | | Thermal Transmittance | | | | | | | | | | | | | | | | |
| | | | Water Infiltration | 3.4.5 | | | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | | |
| | | | Manufacturer's Instructions | 3.3 | | | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | | |
| | | | Manufacturer's Product Warranty | 3.6 | | | | | | | | | | | | | | | |

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| | | 08 71 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Manufacturer's Detail Drawings | 1.3 | G | AE | | | | | | | | | | | | |
| | | | Verification of Existing Conditions | 1.3 | G | AE | | | | | | | | | | | | |
| | | | Hardware Schedule | 1.5 | G | AE | | | | | | | | | | | | |
| | | | Keying System | 2.3.8 | G | AE | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Hardware Items | 2.3 | G | AE | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | |
| | | | Installation | 3.1 | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | |
| | | | Hardware Schedule | 1.5 | G | RO | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | Key Bitting | 1.6.1 | | | | | | | | | | | | | | |
| | | 08 81 00 | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Insulating Glass | 2.2 | G | AE | | | | | | | | | | | | |
| | | | Glazing Accessories | 1.3 | G | AE | | | | | | | | | | | | |
| | | | Sealants | 2.3.3.1 | G | AE | | | | | | | | | | | | |
| | | | Joint Backer | 2.3.4 | G | AE | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | |
| | | | Insulating Glass | 2.2 | G | AE | | | | | | | | | | | | |
| | | | Glazing Compound | 2.3.2 | | | | | | | | | | | | | | |
| | | | Tape | 2.3.6 | | | | | | | | | | | | | | |
| | | | Sealing Tapes | 2.3.6 | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Insulating Glass | 2.2 | G | RO | | | | | | | | | | | | |

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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 | G | RO | | | | | | | | | | | | |
| | | | Monolithic Opacified Spandrel | 1.7.2 | | | | | | | | | | | | | | |
| | | 08 91 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Wall Louvers | 1.4 | G | AE | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Metal Wall Louvers | 2.2 | G | AE | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | |
| | | | Wall Louver Samples | 1.5 | G | AE | | | | | | | | | | | | |
| | | 09 22 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Metal Support Systems | 2.1 | G | AE | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Metal Support Systems | 2.1 | G | AE | | | | | | | | | | | | |
| | | | Recycled Content for Metal | 2.1 | | | | | | | | | | | | | | |
| | | | Support Systems | | | | | | | | | | | | | | | |
| | | 09 29 00 | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Cementitious Backer Units | 2.1.3 | G | AE | | | | | | | | | | | | |
| | | | Accessories | 2.1.6 | G | AE | | | | | | | | | | | | |
| | | | Gypsum Board | 2.1.1 | G | AE | | | | | | | | | | | | |
| | | | Recycled Content for Gypsum | 2.1.1 | | | | | | | | | | | | | | |
| | | | Board | | | | | | | | | | | | | | | |
| | | | Recycled Content for Paper | 2.1.1 | | | | | | | | | | | | | | |
| | | | Facing and Gypsum Cores | | | | | | | | | | | | | | | |

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| | | 09 29 00 | VOC Content of Joint Compound | 2.1.4 | | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | ASTM E90 Factory Test Report | 2.1.2.1 | G | RO | | | | | | | | | | | | | |
| | | | ASTM E90 Factory Test Report | 3.7 | G | RO | | | | | | | | | | | | | |
| | | | ASTM E90 Factory Test Report | 3.9 | G | RO | | | | | | | | | | | | | |
| | | | ASTM E336 Field Test Report | 3.9 | G | RO | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Asbestos Free Materials | 2.1 | G | RO | | | | | | | | | | | | | |
| | | | Indoor Air Quality for Gypsum | 2.1.1 | | | | | | | | | | | | | | | |
| | | | Board | | | | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer's Instructions | | | | | | | | | | | | | | | | |
| | | | Safety Data Sheets | 2.1 | | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | | |
| | | | Manufacturer Maintenance | 2.1 | | | | | | | | | | | | | | | |
| | | | Instructions | | | | | | | | | | | | | | | | |
| | | 09 30 10 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Detail Drawings | 3.2 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Porcelain Tile | 2.1.1 | G | AE | | | | | | | | | | | | | |
| | | | Recycled Content for Porcelain | 2.1.1 | | | | | | | | | | | | | | | |
| | | | Tile | | | | | | | | | | | | | | | | |
| | | | Mosaic Tile | 1.3.2 | G | AE | | | | | | | | | | | | | |
| | | | Transition Strips | 2.1 | | | | | | | | | | | | | | | |
| | | | Transition Strips | 2.6.1 | | | | | | | | | | | | | | | |
| | | | Metal Strips | 2.6.2 | | | | | | | | | | | | | | | |

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| | | 09 30 10 | Setting-Bed | 2.2 | | | | | | | | | | | | | | | |
| | | | Mortar, Grout, and Adhesive | 2.4 | | | | | | | | | | | | | | | |
| | | | Cementitious Backer Units | 2.5.1 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Tile | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Accessories | 2.1 | | | | | | | | | | | | | | | |
| | | | Transition Strips | 2.1 | | | | | | | | | | | | | | | |
| | | | Transition Strips | 2.6.1 | | | | | | | | | | | | | | | |
| | | | Metal Strips | 2.6.2 | | | | | | | | | | | | | | | |
| | | | Grout | 2.4.2 | G | AE | | | | | | | | | | | | | |
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| | | | Indoor Air Quality for Adhesives | 2.4 | | | | | | | | | | | | | | | |
| | | | Indoor Air Quality for Sealants | 2.4.3 | | | | | | | | | | | | | | | |
| | | | Water Absorption Rates | 1.3.2 | | | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | | |
| | | | Manufacturer's Approved | 3.7 | | | | | | | | | | | | | | | |
| | | | Cleaning Instructions | | | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | | |
| | | | Porcelain Tile | 2.1.1 | | | | | | | | | | | | | | | |
| | | | Mosaic Tile | 1.3.2 | G | RO | | | | | | | | | | | | | |
| | | | Transition Strips | 2.1 | G | RO | | | | | | | | | | | | | |
| | | | Transition Strips | 2.6.1 | G | RO | | | | | | | | | | | | | |
| | | | Metal Strips | 2.6.2 | G | RO | | | | | | | | | | | | | |
| | | 09 51 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Approved Detail Drawings | 2.1 | G | AE | | | | | | | | | | | | | |

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| | | 09 51 00 | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Recycled Content for Type XII | 2.2.1.1 | | | | | | | | | | | | | | | |
| | | | Ceiling Tiles | | | | | | | | | | | | | | | | |
| | | | Recycled Content for Suspension | 2.3 | | | | | | | | | | | | | | | |
| | | | Systems | | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Acoustical Units | 2.2 | | | | | | | | | | | | | | | |
| | | | Acoustical Ceiling Tiles | 2.2.1.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Indoor Air Quality for Type XII | 2.2.1.1 | | | | | | | | | | | | | | | |
| | | | Ceiling Tiles | | | | | | | | | | | | | | | | |
| | | | Indoor Air Quality for Sealants | 2.8 | | | | | | | | | | | | | | | |
| | | 09 54 23 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Linear Metal Ceiling Panels | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | Metal Suspension Systems | 2.3 | G | AE | | | | | | | | | | | | | |
| | | | Aluminum Panels And | 2.4 | G | AE | | | | | | | | | | | | | |
| | | | Suspension System For Linear | | | | | | | | | | | | | | | | |
| | | | Metal Ceiling | | | | | | | | | | | | | | | | |
| | | | Installation | 3.3 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Linear Metal Ceiling Panels | 2.2 | | | | | | | | | | | | | | | |
| | | | Metal Suspension Systems | 2.3 | | | | | | | | | | | | | | | |
| | | | Aluminum Panels And | 2.4 | | | | | | | | | | | | | | | |
| | | | Suspension System For Linear | | | | | | | | | | | | | | | | |
| | | | Metal Ceiling | | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |

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| | | 09 54 23 | Linear Metal Ceiling Panels | 2.2 | G | RO | | | | | | | | | | | | |
| | | | Metal Suspension Systems | 2.3 | G | RO | | | | | | | | | | | | |
| | | | Aluminum Panels And | 2.4 | | | | | | | | | | | | | | |
| | | | Suspension System For Linear | | | | | | | | | | | | | | | |
| | | | Metal Ceiling | | | | | | | | | | | | | | | |
| | | | Finishes | 2.5 | G | RO | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | |
| | | | Finishes | 2.5 | G | RO | | | | | | | | | | | | |
| | | | Extra Materials | 1.3 | G | RO | | | | | | | | | | | | |
| | | 09 65 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Resilient Flooring and | 2.7 | G | AE | | | | | | | | | | | | |
| | | | Accessories | | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Resilient Flooring and | 2.7 | G | AE | | | | | | | | | | | | |
| | | | Accessories | | | | | | | | | | | | | | | |
| | | | Adhesives | 2.3 | | | | | | | | | | | | | | |
| | | | Luxury Vinyl Tile | 2.1 | G | AE | | | | | | | | | | | | |
| | | | Recycled content for Luxury Vinyl | 2.1 | | | | | | | | | | | | | | |
| | | | Tile | | | | | | | | | | | | | | | |
| | | | Wall Base | 2.2 | G | AE | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | |
| | | | Resilient Flooring and | 2.7 | G | AE | | | | | | | | | | | | |
| | | | Accessories | | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
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| | | 09 65 00 | Moisture, Alkalinity and Bond | 3.3 | | | | | | | | | | | | | | | |
| | | | Tests | | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Indoor Air Quality for Luxury Vinyl | 2.1 | | | | | | | | | | | | | | | |
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| | | | Indoor Air Quality for Adhesives | 2.3 | | | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | | |
| | | | Surface Preparation | 3.2 | | | | | | | | | | | | | | | |
| | | | Installation | 3.1 | | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | | |
| | | | Resilient Flooring and | 2.7 | | | | | | | | | | | | | | | |
| | | | Accessories | | | | | | | | | | | | | | | | |
| | | 09 67 23.13 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Installation Drawings | 2.1 | | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Manufacturer's Catalog Data | 1.2.2 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Hardboard Mounted Flooring | 1.5.3 | G | AE | | | | | | | | | | | | | |
| | | | Mockups | 1.5.1 | G | | | | | | | | | | | | | | |
| | | | SD-05 Design Data | | | | | | | | | | | | | | | | |
| | | | Design Mix Data | 1.2.3 | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Listing of Product Installations | 1.5.2 | | | | | | | | | | | | | | | |
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| | | 09 67 23.13 | Referenced Standards | 1.5 | | | | | | | | | | | | | | | |
| | | | Certificates | | | | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | | |
| | | | Warranty | 1.6 | | | | | | | | | | | | | | | |
| | | 09 67 23.16 | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Joint Sealant | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Epoxy Mortar Flooring System | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | White Aluminum Oxide Non-Skid | 2.3 | G | AE | | | | | | | | | | | | | |
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| | | | SD-05 Design Data | | | | | | | | | | | | | | | | |
| | | | Environmental Control System | 1.3.3.1 | | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Joint Sealant Test Report | 1.3.4.1 | | | | | | | | | | | | | | | |
| | | | Primer Coat | 2.2.1 | | | | | | | | | | | | | | | |
| | | | Epoxy Mortar Coat | 2.2.2 | | | | | | | | | | | | | | | |
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| | | | Patch Test Demonstration | 1.7 | | | | | | | | | | | | | | | |
| | | | Daily Inspection Report | 1.3.4.2 | | | | | | | | | | | | | | | |
| | | | Adhesion Testing | 3.12.3 | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Coating Work Plan | 1.3.2 | G | RO | | | | | | | | | | | | | |
| | | | Qualifications of Coating | 1.3.5.5 | G | RO | | | | | | | | | | | | | |
| | | | Contractors | | | | | | | | | | | | | | | | |

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| | | 09 67 23.16 | Joint Sealant Certificates | 1.3.5.6 | G | RO | | | | | | | | | | | | |
| | | | Epoxy Mortar Flooring System | 1.3.5.7 | G | RO | | | | | | | | | | | | |
| | | | Certificates | | | | | | | | | | | | | | | |
| | | | Qualifications of Certified | 1.3.5.1 | | | | | | | | | | | | | | |
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| | | | Qualifications of Certified | 1.3.5.2 | | | | | | | | | | | | | | |
| | | | Protective Coatings Specialist | | | | | | | | | | | | | | | |
| | | | (PCS) | | | | | | | | | | | | | | | |
| | | | Qualifications of Coating | 1.3.5.3 | | | | | | | | | | | | | | |
| | | | Inspection Company | | | | | | | | | | | | | | | |
| | | | Qualifications of QC Specialist | 1.3.5.4 | | | | | | | | | | | | | | |
| | | | Coating Inspector | | | | | | | | | | | | | | | |
| | | | Warranty | 1.8 | | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | |
| | | | Joint Sealant Manufacturer's | 1.3.6.1 | | | | | | | | | | | | | | |
| | | | Instructions | | | | | | | | | | | | | | | |
| | | | Epoxy Mortar Flooring System | 1.3.6.2 | | | | | | | | | | | | | | |
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| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | Inspection Logbook | 3.12.2.2 | | | | | | | | | | | | | | |
| | | 09 68 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Installation Drawings | 3.4 | G | AE | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Carpet | 2.1 | G | AE | | | | | | | | | | | | |
| | | | Recycled Content for Carpeting | 2.1.1 | S | | | | | | | | | | | | | |

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| | | 09 68 00 | Indoor Air Quality for Non-Aerosol Adhesives | 2.3 | S | | | | | | | | | | | | | | |
| | | | Indoor Air Quality for Concrete Primer | 2.3 | S | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Carpet | 2.1 | G AE | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Moisture and Alkalinity Tests | 3.2 | G AE | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | 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 | | | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | | |
| | | | Warranty | 1.6 | | | | | | | | | | | | | | | |
| | | 09 90 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Piping Identification | 3.11 | | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Coating | 2.1 | | | | | | | | | | | | | | | |
| | | | Product Data Sheets | 2.1 | | | | | | | | | | | | | | | |
| | | | Sealant | 3.3.5 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Color | 2.2 | | | | | | | | | | | | | | | |
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| | | 09 90 00 | Qualification Testing | 1.6.6.2 | | | | | | | | | | | | | | |
| | | | Indoor Air Quality for Paints and | 1.6.5 | | | | | | | | | | | | | | |
| | | | Primers | | | | | | | | | | | | | | | |
| | | | SD-08 Manufacturer’s Instructions | | | | | | | | | | | | | | | |
| | | | Application Instructions | 3.4.1 | | | | | | | | | | | | | | |
| | | | Mixing | 2.1 | | | | | | | | | | | | | | |
| | | | Manufacturer's Safety Data | 1.8.1 | | | | | | | | | | | | | | |
| | | | Sheets | | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | |
| | | | Coatings | 2.1 | | | | | | | | | | | | | | |
| | | 10 14 00.10 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Approved Detail Drawings | 3.1 | G | AE | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Modular Exterior Signage System | 2.1 | | | | | | | | | | | | | | |
| | | | Installation | 3.1 | | | | | | | | | | | | | | |
| | | | Exterior Signage | 1.2 | G | AE | | | | | | | | | | | | |
| | | | Wind Load Requirements | 1.2.1 | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | |
| | | | Exterior Signage | 1.2 | G | AE | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | |
| | | | Protection and Cleaning | 3.1.2 | | | | | | | | | | | | | | |
| | | 10 14 00.20 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Detail Drawings | 1.4.2 | G | AE | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |

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| | | 10 14 00.20 | Room Identification Signage | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | System | | | | | | | | | | | | | | | | |
| | | | Stair Signage | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | Exit Door Tactile Sign | 2.3 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Interior Signage | 1.4.1 | G | AE | | | | | | | | | | | | | |
| | | | Software | 1.3 | | | | | | | | | | | | | | | |
| | | | Room Identification Signage | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | System | | | | | | | | | | | | | | | | |
| | | | Stair Signage | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | Exit Door Tactile Sign | 2.3 | G | AE | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | | |
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| | | | Approved Manufacturer's | 3.1 | G | | | | | | | | | | | | | | |
| | | | Instructions | | | | | | | | | | | | | | | | |
| | | | Protection and Cleaning | 3.1.2 | G | | | | | | | | | | | | | | |
| | | 10 22 13 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Wire Mesh Partitions | 1.4 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Wire Mesh Partitions | 1.4 | G | AE | | | | | | | | | | | | | |
| | | | Recycled Content for Metal Post | 2.1 | | | | | | | | | | | | | | | |
| | | | and Framing Materials | | | | | | | | | | | | | | | | |
| | | | Recycled Content for Wire | 2.1 | | | | | | | | | | | | | | | |
| | | | Materials | | | | | | | | | | | | | | | | |
| | | 10 26 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Corner Guards | 2.2 | G | AE | | | | | | | | | | | | | |

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| | | 10 26 00 | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Corner Guards | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | Wall Covering and Panels | 2.3 | G | AE | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Corner Guards | 2.2 | G | AE | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Fire Resistance Rating | 2.1.1.2 | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Indoor air quality for wall | 2.3 | | | | | | | | | | | | | | | |
| | | | covering/panels | | | | | | | | | | | | | | | | |
| | | | Indoor air quality for adhesives | 2.5 | | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | | |
| | | | Corner Guards | 2.2 | G | RO | | | | | | | | | | | | | |
| | | 10 28 13 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Product Schedule | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Recycled content for stainless | 2.1 | | | | | | | | | | | | | | | |
| | | | steel toilet accessories | | | | | | | | | | | | | | | | |
| | | | Item A5030 | 2.1.3 | G | AE | | | | | | | | | | | | | |
| | | | Item A5080 | 2.1.4 | G | AE | | | | | | | | | | | | | |
| | | | Item A5090 | 2.1.5 | G | AE | | | | | | | | | | | | | |
| | | | Item A5109 | 2.1.6 | G | AE | | | | | | | | | | | | | |
| | | | Item A5110 | 2.1.7 | G | AE | | | | | | | | | | | | | |
| | | | Item A5135 | 2.1.8 | G | AE | | | | | | | | | | | | | |
| | | | Item A5145 | 2.1.9 | G | AE | | | | | | | | | | | | | |

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| | | 10 28 13 | Item A5170 | 2.1.10 | G | AE | | | | | | | | | | | | | |
| | | | Item A5200 | 2.1.11 | G | AE | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | | |
| | | | Item A5030 | 2.1.3 | G | RO | | | | | | | | | | | | | |
| | | | Item A5080 | 2.1.4 | G | RO | | | | | | | | | | | | | |
| | | | Item A5090 | 2.1.5 | G | RO | | | | | | | | | | | | | |
| | | | Item A5109 | 2.1.6 | G | RO | | | | | | | | | | | | | |
| | | | Item A5110 | 2.1.7 | G | RO | | | | | | | | | | | | | |
| | | | Item A5135 | 2.1.8 | G | RO | | | | | | | | | | | | | |
| | | | Item A5145 | 2.1.9 | G | RO | | | | | | | | | | | | | |
| | | | Item A5170 | 2.1.10 | G | RO | | | | | | | | | | | | | |
| | | | Item A5200 | 2.1.11 | G | RO | | | | | | | | | | | | | |
| | | 10 44 16 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Fire Extinguishers | 2.1.1 | | | | | | | | | | | | | | | |
| | | | Accessories | Part 2 | | | | | | | | | | | | | | | |
| | | | Cabinets | Part 2 | | | | | | | | | | | | | | | |
| | | | Wall Brackets | 2.2.2 | | | | | | | | | | | | | | | |
| | | | Schedule | 1.5 | | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Fire Extinguishers | 2.1.1 | | | | | | | | | | | | | | | |
| | | | Accessories | Part 2 | | | | | | | | | | | | | | | |
| | | | Cabinets | Part 2 | | | | | | | | | | | | | | | |
| | | | Wall Brackets | 2.2.2 | | | | | | | | | | | | | | | |
| | | | Replacement Parts List | 3.2.1 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |

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| | | 10 44 16 | Equipment Samples | 1.3.1 | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Fire Extinguishers Certifications | 2.1.1 | | | | | | | | | | | | | | | |
| | | | Manufacturer's Warranty with | 1.4 | G | | | | | | | | | | | | | | |
| | | | Inspection Tag | | | | | | | | | | | | | | | | |
| | | 10 51 13 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Types | 2.1 | G | AE | | | | | | | | | | | | | |
| | | | Location | 1.4 | G | AE | | | | | | | | | | | | | |
| | | | Installation | 3.1 | | | | | | | | | | | | | | | |
| | | | Numbering system | 3.2 | | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Material | 2.2 | | | | | | | | | | | | | | | |
| | | | Handles | 2.3.2 | | | | | | | | | | | | | | | |
| | | | Finish | 2.2.2 | | | | | | | | | | | | | | | |
| | | | components | 2.3 | | | | | | | | | | | | | | | |
| | | | Assembly | 3.1 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |
| | | | Color chips | 1.5.1 | G | AE | | | | | | | | | | | | | |
| | | 12 50 00.13 10 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
| | | | Storage Location | 1.7.3 | | | | | | | | | | | | | | | |
| | | | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Installation Drawings | 3.3.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Product Data | 2.3 | | | | | | | | | | | | | | | |
| | | | Product Style Options | 2.3 | | | | | | | | | | | | | | | |
| | | | SD-04 Samples | | | | | | | | | | | | | | | | |

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| | | 12 50 00.13 10 | Fabric and Finishes | 2.3.4 | G | RO | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Authorized Dealer | 1.6 | | | | | | | | | | | | | | |
| | | | Certified Furniture Installers | 1.6 | | | | | | | | | | | | | | |
| | | | Licensed Electrician | 1.6 | | | | | | | | | | | | | | |
| | | | Certified Telecommunications Installer | 1.6 | | | | | | | | | | | | | | |
| | | | Manufacturer's Certification | 2.3 | | | | | | | | | | | | | | |
| | | | Warranty | 1.8 | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance Data | | | | | | | | | | | | | | | |
| | | | Furniture, Data Package 1 | 3.5 | G | RO | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | Energy Efficient Equipment | 2.1.1 | | | | | | | | | | | | | | |
| | | | Reduced VOC's for Furniture | 2.1.2 | | | | | | | | | | | | | | |
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| | | | Bio-Based Content of Furniture | 2.1.4 | | | | | | | | | | | | | | |
| | | 13 48 73 | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Bracing | 3.1 | G | AE | | | | | | | | | | | | |
| | | | Equipment Requirements | 2.1 | | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Bracing | 3.1 | G | AE | | | | | | | | | | | | |
| | | | Equipment Requirements | 2.1 | | | | | | | | | | | | | | |
| | | | Anchor Bolts | 3.3 | | | | | | | | | | | | | | |
| | | | Vibration Isolators | 2.1.2 | | | | | | | | | | | | | | |
| | | | SD-05 Design Data | | | | | | | | | | | | | | | |

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| | | 13 48 73 | Design Calculations | 1.2.3 | G | AE | | | | | | | | | | | | |
| | | | Anchor Bolts | 3.3 | | | | | | | | | | | | | | |
| | | 21 13 13 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |
| | | | Qualified Fire Protection Engineer | 1.2.3 | G | AE | | | | | | | | | | | | |
| | | | (QFPE) | | | | | | | | | | | | | | | |
| | | | Sprinkler System Designer | 1.4.2.1 | G | AE | | | | | | | | | | | | |
| | | | Sprinkler System Installer | 1.4.2.2 | G | AE | | | | | | | | | | | | |
| | | | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Shop Drawing | 1.2.1.1 | G | AE | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Steel Pipe | 2.2.1.1 | G | AE | | | | | | | | | | | | |
| | | | Fittings | 2.2.1.2 | G | AE | | | | | | | | | | | | |
| | | | Valves | 2.2.4 | G | AE | | | | | | | | | | | | |
| | | | Relief Valves | 2.4.4 | G | AE | | | | | | | | | | | | |
| | | | Sprinklers | 2.3 | G | AE | | | | | | | | | | | | |
| | | | Pipe Hangers and Supports | 2.2.3 | G | AE | | | | | | | | | | | | |
| | | | Air Vent | 2.4.5 | G | AE | | | | | | | | | | | | |
| | | | Nameplates | 2.1.2 | G | AE | | | | | | | | | | | | |
| | | | SD-05 Design Data | | | | | | | | | | | | | | | |
| | | | Hydraulic Calculations | 1.2.1.2 | G | AE | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
| | | | Test Procedures | 3.6.1 | G | AE | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Verification of Compliant | 3.6.2.1 | G | AE | | | | | | | | | | | | |
| | | | Installation | | | | | | | | | | | | | | | |
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| | | 21 13 13 | Request for Government Final | 3.6.2.2 | G | AE | | | | | | | | | | | | | |
| | | | Test | | | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | | |
| | | | Operating and Maintenance | 3.8 | | | | | | | | | | | | | | | |
| | | | (O&M) Instructions | | | | | | | | | | | | | | | | |
| | | | Spare Parts | 1.6 | | | | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | | |
| | | | As-built drawings | 3.8 | G | AE | | | | | | | | | | | | | |
| | | 22 00 00 | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Plumbing System | 3.8.1 | G | AE | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Recycled Content for Steel Pipe | 2.1 | | | | | | | | | | | | | | | |
| | | | Recycled Content for Cast Iron | 2.1 | | | | | | | | | | | | | | | |
| | | | Pipe | | | | | | | | | | | | | | | | |
| | | | Backflow Prevention Assemblies | 3.8.1.1 | G | AE | | | | | | | | | | | | | |
| | | | Shower Faucets | 2.6.2 | G | AE | | | | | | | | | | | | | |
| | | | WaterSense Label for Lavatory | 2.4.1 | | | | | | | | | | | | | | | |
| | | | Faucet | | | | | | | | | | | | | | | | |
| | | | Fixtures | 2.4 | | | | | | | | | | | | | | | |
| | | | Flush Valve Water Closets | 2.4.3 | | | | | | | | | | | | | | | |
| | | | WaterSense Label for Flush | 2.4.3 | | | | | | | | | | | | | | | |
| | | | Valve Water Closet | | | | | | | | | | | | | | | | |
| | | | Flush Valve Urinals | 2.4.4 | | | | | | | | | | | | | | | |
| | | | WaterSense Label for Urinal | 2.4.4 | | | | | | | | | | | | | | | |
| | | | Wall Hung Lavatories | 2.4.6 | | | | | | | | | | | | | | | |

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| | | 22 00 00 | Countertop Lavatories | 2.4.7 | | | | | | | | | | | | | | |
| | | | Kitchen Sinks | 2.4.8 | | | | | | | | | | | | | | |
| | | | Drinking-Water Coolers | 2.4.9 | G | AE | | | | | | | | | | | | |
| | | | Energy Star Label for Electric | 2.4.9 | | | | | | | | | | | | | | |
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| | | | Energy Star Label for Wheelchair | 2.4.10 | | | | | | | | | | | | | | |
| | | | Electric Water Cooler | | | | | | | | | | | | | | | |
| | | | WaterSense Label for | 2.6.2 | | | | | | | | | | | | | | |
| | | | Showerhead | | | | | | | | | | | | | | | |
| | | | Water Heaters | 2.8 | G | AE | | | | | | | | | | | | |
| | | | Energy Star Label for Gas | 2.8.1.1 | | | | | | | | | | | | | | |
| | | | Storage Water Heater | | | | | | | | | | | | | | | |
| | | | Pumps | 2.9 | G | AE | | | | | | | | | | | | |
| | | | Vibration-Absorbing Features | 3.4 | G | AE | | | | | | | | | | | | |
| | | | Plumbing System | 3.8.1 | | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
| | | | Tests, Flushing and Disinfection | 3.8 | | | | | | | | | | | | | | |
| | | | Test of Backflow Prevention | 3.8.1.1 | G | RO | | | | | | | | | | | | |
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| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Materials and Equipment | 1.3 | | | | | | | | | | | | | | |
| | | | Bolts | 2.1.1 | | | | | | | | | | | | | | |
| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | |
| | | | Data | | | | | | | | | | | | | | | |
| | | | Plumbing System | 3.8.1 | G | RO | | | | | | | | | | | | |
| | | 23 05 15 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | |

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| | | 23 05 15 | Material, Equipment, and Fixture | 1.2 | G | RO | | | | | | | | | | | | |
| | | | Lists | | | | | | | | | | | | | | | |
| | | | SD-02 Shop Drawings | | | | | | | | | | | | | | | |
| | | | Record Drawings | 1.2 | G | AE | | | | | | | | | | | | |
| | | | Connection Diagrams | 1.2 | G | AE | | | | | | | | | | | | |
| | | | Coordination Drawings | 1.2 | G | AE | | | | | | | | | | | | |
| | | | Fabrication Drawings | 1.2 | G | AE | | | | | | | | | | | | |
| | | | Installation Drawings | 3.1 | G | AE | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
| | | | Pipe and Fittings | 2.1 | G | AE | | | | | | | | | | | | |
| | | | Piping Specialties | 2.2 | G | AE | | | | | | | | | | | | |
| | | | Valves | 2.3 | G | AE | | | | | | | | | | | | |
| | | | Miscellaneous Materials | 2.4 | G | AE | | | | | | | | | | | | |
| | | | Supporting Elements | 2.5 | G | AE | | | | | | | | | | | | |
| | | | SD-05 Design Data | | | | | | | | | | | | | | | |
| | | | Pipe and Fittings | 2.1 | G | RO | | | | | | | | | | | | |
| | | | Piping Specialties | 2.2 | G | RO | | | | | | | | | | | | |
| | | | Valves | 2.3 | G | RO | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | |
| | | | Hydrostatic Tests | 3.1 | G | RO | | | | | | | | | | | | |
| | | | Air Tests | 3.1 | G | RO | | | | | | | | | | | | |
| | | | Valve-Operating Tests | 3.1 | G | RO | | | | | | | | | | | | |
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| | | | Pneumatic Tests | 3.1 | G | RO | | | | | | | | | | | | |
| | | | Non-Destructive Electric Tests | 3.1 | G | RO | | | | | | | | | | | | |
| | | | System Operation Tests | 3.1 | G | RO | | | | | | | | | | | | |

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| | | | Records of Existing Conditions | 1.2 | G | RO | | | | | | | | | | | | | |
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| | | | Coupling and Bracing | 3.1 | G | AE | | | | | | | | | | | | | |
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| | | | Pipe Insulation Systems | 2.3 | G | AE | | | | | | | | | | | | |
| | | | Pipe Insulation Systems | 3.2 | G | AE | | | | | | | | | | | | |
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| | | | Instructions | 2.2.2 | G | AE | | | | | | | | | | | | |
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| | | | SD-03 Product Data | | | | | | | | | | | | | | | |
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| | | | Cybersecurity Riser Diagram | 1.8.4 | G | AE | | | | | | | | | | | | | |

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| | | 25 05 11.21 | SD-03 Product Data | | | | | | | | | | | | | | | | |
| | | | Control System Cybersecurity | 1.8.6 | G | AE | | | | | | | | | | | | | |
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| | | | Device Audit Record Upload | 3.5.4.2 | G | RO | | | | | | | | | | | | | |
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| | | 25 05 11.23 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |

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| | | | Contractor Temporary Network | 1.10.6 | G | RO | | | | | | | | | | | | |
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| | | | Control System Cybersecurity | 3.14.1 | G | RO | | | | | | | | | | | | |
| | | | Testing Procedures | | | | | | | | | | | | | | | |
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| | | 25 05 11.23 | Control System Cybersecurity Testing Report | 3.14.3 | G | RO | | | | | | | | | | | | |
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| | | | Software Licenses | 1.9 | G | RO | | | | | | | | | | | | |
| | | | SD-11 Closeout Submittals | | | | | | | | | | | | | | | |
| | | | Password Change Summary Report | 3.4.5.5 | G | RO | | | | | | | | | | | | |
| | | | Enclosure Keys | 3.3.5 | G | RO | | | | | | | | | | | | |
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| | | | Control System Inventory Report | 1.8.4 | G | AE | | | | | | | | | | | | |
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| | | | Multiple Ethernet Connection Device Request | 3.2.4.2 | G | RO | | | | | | | | | | | | |
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| | | | Control System Inventory Report | 1.8.4 | G | RO | | | | | | | | | | | | |
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| | | | Power Meters | 2.1 | G | RO | | | | | | | | | | | | |
| | | | Communications Module | 2.2.2 | G | RO | | | | | | | | | | | | |

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| | | | Each major component | 1.4.1.2 | G | RO | | | | | | | | | | | | |
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| | | | Grounding System Test | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | |
| | | | Lightning Protection System | 1.2.3 | G | RO | | | | | | | | | | | | |
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| | | | Component UL Listed and | 1.4.2 | G | RO | | | | | | | | | | | | |
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| | | | Roof manufacturer's warranty | 3.1.1 | G | RO | | | | | | | | | | | | |
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| | | | Contractor's Modifications | 2.1.2.6 | G | AE | | | | | | | | | | | | |
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| | | | Photometric Plan | 1.5.8 | G | RO | | | | | | | | | | | | |
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| | | | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | |
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| | | | LED Drivers | 2.4 | | | | | | | | | | | | | | | |
| | | | Luminaire Warranty | 1.6.1 | G | RO | | | | | | | | | | | | | |
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| | | | Obstruction Marker Luminaires | 2.2.2 | G | RO | | | | | | | | | | | | | |
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| | | | Luminaire Design Data | 1.5.2 | G | RO | | | | | | | | | | | | | |
| | | | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | ANSI/IES LM-79 Test Report | 1.5.3 | | | | | | | | | | | | | | | |
| | | | ANSI/IES LM-80 Test Report | 1.5.4 | | | | | | | | | | | | | | | |
| | | | ANSI/IES TM-21 Test Report | 1.5.5 | | | | | | | | | | | | | | | |
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| | | 26 56 00 | SD-10 Operation and Maintenance | | | | | | | | | | | | | | | | |
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| | | | Supports | 1.2.1 | G | RO | | | | | | | | | | | | | |
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| | | | Telecommunications Space | 1.6.1.2 | G | RO | | | | | | | | | | | | | |
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| | | | Equipment Support Frame | 2.4.2 | G | RO | | | | | | | | | | | | | |
| | | | Connector Blocks | 2.4.3 | G | RO | | | | | | | | | | | | | |
| | | | Spare Parts | 1.10.3 | G | RO | | | | | | | | | | | | | |

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| | | 27 10 00 | SD-06 Test Reports | | | | | | | | | | | | | | | | |
| | | | Telecommunications Cabling | 3.5.1 | G | RO | | | | | | | | | | | | | |
| | | | Testing | | | | | | | | | | | | | | | | |
| | | | SD-07 Certificates | | | | | | | | | | | | | | | | |
| | | | Telecommunications Contractor | 1.6.2.1 | G | RO | | | | | | | | | | | | | |
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| | | | Factory Reel Tests | 2.12.1 | G | RO | | | | | | | | | | | | | |
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| | | | Data | | | | | | | | | | | | | | | | |
| | | | Telecommunications Cabling and | 1.10.1 | G | RO | | | | | | | | | | | | | |
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| | | | Record Documentation | 1.10.2 | G | RO | | | | | | | | | | | | | |
| | | 27 13 23.00 40 | SD-01 Preconstruction Submittals | | | | | | | | | | | | | | | | |
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| | | | Quality Assurance Plan | 1.3.1 | G | RO | | | | | | | | | | | | | |
| | | | SD-02 Shop Drawings | | | | | | | | | | | | | | | | |
| | | | Fiber Optic System Contract | 1.3.1 | G | RO | | | | | | | | | | | | | |
| | | | Drawings | | | | | | | | | | | | | | | | |
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| | | | Record (As-Built) Drawings | 3.3 | G | RO | | | | | | | | | | | | | |
| | | | SD-03 Product Data | | | | | | | | | | | | | | | | |

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# SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

B-21: Weapons Loader Training (WLT) Facility, (FY23) - Ellsworth

CONTRACTOR

| ACTIVITY NO | TRANSMITTAL NO | SPEC SECT | DESCRIPTION ITEM SUBMITTED | PARAG # RAPH | CLASSIFICATION | GOVT OR A/E REVWR | CONTRACTOR: SCHEDULE DATES | | | CONTRACTOR ACTION | | | APPROVING AUTHORITY | | | | MAILED TO CONTR/ DATE RCD FRM APPR AUTH | REMARKS |
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| | | | | | | | SUBMIT | APPROVAL NEEDED BY | MATERIAL NEEDED BY | ACTION CODE | DATE OF ACTION | DATE FWD TO APPR AUTH/ 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) |
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# SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

B-21: Weapons Loader Training (WLT) Facility, (FY23) - Ellsworth

CONTRACTOR

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# SUBMITTAL REGISTER

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TITLE AND LOCATION

B-21: Weapons Loader Training (WLT) Facility, (FY23) - Ellsworth

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U.S. Army Corps of Engineers (USACE)

# TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE

For use of this form, see ER 415-1-10; the proponent agency is CECW-CE.

| DATE | TRANSMITTAL NO. |
|---|---|
| | |

**SECTION I - REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS** (*This section will be initiated by the contractor*)

| TO: | FROM: | CONTRACT NO. | CHECK ONE:<br>☐ THIS IS A NEW TRANSMITTAL<br>☐ THIS IS A RESUBMITTAL OF TRANSMITTAL _____ |
|---|---|---|---|

| SPECIFICATION SEC. NO. (*Cover only one section with each transmittal*) | PROJECT TITLE AND LOCATION | THIS TRANSMITTAL IS FOR: (*Check one*)<br>☐ FIO ☐ GA ☐ DA ☐ CR ☐ DA/CR ☐ DA/GA |
|---|---|---|

| ITEM NO. (*See Note 3*) a. | DESCRIPTION OF SUBMITTAL ITEM (*Type size, model number/etc.*) b. | SUBMITTAL TYPE CODE (*See Note 8*) c. | NO. OF COPIES d. | CONTRACT DOCUMENT REFERENCE | | CONTRACTOR REVIEW CODE g. | VARIATION Enter "Y" if requesting a variation (*See Note 6*) h. | USACE ACTION CODE (*Note 9*) i. |
|---|---|---|---|---|---|---|---|---|
| | | | | SPEC. PARA. NO. e. | DRAWING SHEET NO. f. | | | |
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| REMARKS | 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 |

**SECTION II - APPROVAL ACTION**

| ENCLOSURES RETURNED (*List by item No.*) | NAME AND TITLE OF APPROVING AUTHORITY | SIGNATURE OF APPROVING AUTHORITY | DATE |
|---|---|---|---|
| | | | |

## INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.

2. Each Transmittal shall be numbered consecutively. The Transmittal Number typically includes two parts separated by a dash (-). The first part is the specification section number. The second part is a sequential number for the submittals under that spec section. If the Transmittal is a resubmittal, then add a decimal point to the end of the original Transmittal Number and begin numbering the resubmittal packages sequentially after the decimal.

3. The "Item No." for each entry on this form will be the same "Item No." as indicated on ENG FORM 4288-R.

4. Submittals requiring expeditious handling will be submitted on a separate ENG Form 4025-R.

5. Items transmitted on each transmittal form will be from the same specification section. Do not combine submittal information from different specification sections in a single transmittal.

6. If the data submitted are intentionally in variance with the contract requirements, indicate a variation in column h, and enter a statement in the Remarks block describing he detailed reason for the variation.

7. ENG Form 4025-R is self-transmitting - a letter of transmittal is not required.

8. When submittal items are transmitted, indicate the "Submittal Type" (*SD-01 through SD-11*) in column c of Section I.
   Submittal types are the following:
   SD-01 - Preconstruction SD-02 - Shop Drawings SD-03 - Product Data SD-04 - Samples SD-05 - Design Data SD-06 - Test Reports
   SD-07 - Certificates SD-08 - Manufacturer's Instructions SD-09 - Manufacturer's Field Reports SD-10 - O&M Data SD-11 - Closeout

9. For each submittal item, the Contractor will assign Submittal Action Codes in column g of Section I. The U.S. Army Corps of Engineers approving authority will assign Submittal Action Codes in column i of Section I. The Submittal Action Codes are:

   A – Approved as submitted.
   B – Approved, except as noted on drawings. Resubmission not required.
   C – Approved, except as noted on drawings. Refer to attached comments. Resubmission required.
   D – Will be returned by separate correspondence.
   E – Disapproved. Refer to attached comments.
   F – Receipt acknowledged.
   X – Receipt acknowledged, does not comply with contract requirements, as noted.
   G – Other action required *(Specify)*
   K – Government concurs with intermediate design. (*For D-B contracts*)
   R – Design submittal is acceptable for release for construction. (*For D-B contracts*)

10. Approval of items does not relieve the contractor from complying with all the requirements of the contract.

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SECTION 01 33 29

SUSTAINABILITY REQUIREMENTS AND REPORTING

**02/21**

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-- End of Section Table of Contents --

SECTION 01 33 29

SUSTAINABILITY REQUIREMENTS AND REPORTING
**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.

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 |

GREEN BUILDING INITIATIVE (GBI)

| | |
|---|---|
| GBI DOD GP Compliance | (2017) GBI Department of Defense Guiding Principles Compliance Program for New Construction |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IgCC | (2021) International Green Construction Code |

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; Change 2, 2022) High Performance and Sustainable Building Requirements |
| UFC 3-600-01 | (2016; with Change 6, 2021) Fire Protection Engineering for Facilities |

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 247 | Comprehensive Procurement Guideline for Products Containing Recovered Materials |

1.2 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 other identified 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 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

Preliminary High Performance and Sustainable Building Checklist; G

Sustainability Action Plan; G

Preliminary Sustainability eNotebook; G

SD-11 Closeout Submittals

Final High Performance and Sustainable Building Checklist; G

Final Sustainability eNotebook; G

Amended Final Sustainability eNotebook; G

Amended Final High Performance and Sustainable Building Checklist; G

Third Party Certification Certificate, Assessment, or Validation and Compliance Report; G

1.4 GUIDING PRINCIPLES VALIDATION (GPV)

Provide the following sustainability activities and documentation to verify achievement of HPSB Guiding Principles Validation (GPV):

a. Analysis of each Guiding Principle Requirement and how project complies. Include final government approved narrative(s) in the HPSB Checklist submittal. Multiple checklists indicate multiple buildings that require individual HPSB Checklist tracking.

b. 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 approved HPSB Guiding Principles Requirements for this project. Demonstrate the change will not increase the life-cycle cost and maintains or improves the building performance.

c. Documentation of all work required to incorporate the applicable

HPSB Guiding Principles requirements indicated on the HPSB Checklist and in this contract.

d. Sustainability Action Plan.

e. Construction related documentation for the project Sustainability eNotebook and keep updated with regularly-scheduled Construction Quality Control Meetings. Include construction related documentation containing the following components:

(1) HPSB Checklist(s)

(2) Sustainability Action Plan

(3) Documentation illustrating HPSB Guiding Principles Requirements compliance

1.4.1 Sustainability Action Plan

Include the following information in the Sustainability Action Plan:

a. Analysis of each HPSB Guiding Principles Requirement and how project will comply. Final government approved narrative(s) must be included in the HPSB Checklist submittal.

b. Name and contact information for: Contractor's Point of Contact (POC) ensuring sustainability goals are accomplished and documentation is assembled. For TPC that include on-site visit by third party representative, provide list of required attendees.

c. Indoor Air Quality plan.

1.4.2 Calculations

Provide all calculations, product data, labels and product certifications required in this specification to demonstrate compliance with the HPSB Guiding Principles Requirements.

1.5 SUSTAINABILITY SUBMITTALS

Provide HPSB Checklist and other documentation in the Sustainability eNotebook to indicate compliance with the sustainability requirements of the project.

1.5.1 High Performance Sustainable Building (HPSB) Checklist

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

1.5.1.1 HPSB Checklist Submittals

Submit updated HPSB Checklist, Attachment 1 at the end of this section, with each Sustainability eNotebook submittal. Include the final HPSB Checklist(s) with the interim DD1354 Real Property Record Submittal.

1.5.2 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 checklist Attachment 2 at the end of this section, 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. HPSB checklist

b. Sustainability Action Plan

c. Calculations

d. Labels

e. Certifications, assessments, or validations and compliance report

f. TPC documentation required in paragraph THIRD PARTY CERTIFICATION (TPC).

1.5.2.1 Sustainability eNotebook Format

Provide Sustainability eNotebook in the form of an Adobe PDF file; bookmark each HPSB Guiding Principles Requirement, TPC requirement, 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.

1.5.2.2 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.

b. Construction Quality Control Meetings.

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

c. Final Sustainability eNotebook

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

d. 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 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.

1.6.1 Commissioning (Cx)

Develop and incorporate Commissioning requirements into the documents, in accordance with Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING.

1.6.2 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.

1.6.3 Building-level Power Metering

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

1.6.3.1 Construction Submittal Documentation

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

1.6.4 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.

1.6.5 Indoor Water Metering

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

1.6.5.1 Construction Submittal Documentation

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

1.6.6 Moisture Control

Provide the following:

1.6.6.1 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 10 QUALITY CONTROL.

1.6.7 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.

1.6.8 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.

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.

1.6.9 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.

1.6.9.1 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.

1.6.10 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.

1.6.11 Waste Material Management (Recycling – Construction)

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

1.6.12 Additional Sustainability Requirements

Provide the additional sustainability requirements cited in this paragraph.

1.6.12.1 Third Party Certification (TPC) Documentation

Third Party Certification certificate, assessment, or validation, and compliance report requirements are in addition to all requirements under header above GUIDING PRINCIPLES VALIDATION (GPV).

1.6.12.1.1 TPC Registration

This project has been designed for, and must be constructed to achieve GBI DOD GP Compliance. Project is already registered with the TPC Organization. Provide construction related sustainability documentation, in the format required by the TPC Organization, to the Contracting Officer for approval, and for final approval by the TPC organization. Third Party Certification is met when Government receives TPC organization certificate, assessment, or validation and compliance report. Execute the following:

a. Refer to TPC Checklist at the end of this specification section. (Multiple checklists indicate multiple buildings that require TPC.)

b. Immediately bring to the attention of the Contracting Officer any project changes that impact meeting the approved TPC Requirements for this project. Demonstrate the change will not increase the life-cycle cost and maintains or improves the building performance.

c. Complete all work required to incorporate the applicable TPC Requirements.

d. Maintain the construction related information in the Sustainability eNotebook pertaining to additions and changes to the approved sustainability requirements. Maintain the Sustainability eNotebook in electronic format. For more explanation, refer to paragraph SUSTAINABILITY eNOTEBOOK. Provide the following components in the Sustainability eNotebook, in addition to the GPV components above:

(1) TPC Checklist

(2) Provide construction documentation required to achieve third party certification

e. Provide the following information in the Sustainability Action Plan. Provide this TPC information in addition to the GPV Action Plan items above:

(1) Planned method to achieve each TPC requirement.

(2) 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.

(3) Provide name and contact information for: Sustainability Point of Contact (POC) and other names of sustainability professionals responsible for ensuring TPC sustainability goals are accomplished and documentation is assembled. Sustainability POCs are also responsible for ensuring GPV required in paragraph GUIDING PRINCIPLES VALIDATION (GPV) above.

f. 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) TPC coordination with Government's AE and other consultants, TPC website requirements, and management for construction related documentation.

(2) Construction work required to incorporate TPC requirements.

(3) Submittals required to demonstrate compliance with Government approved TPC checklists.

(4) Documentation illustrating compliance with TPC requirements and additional documentation required by the TPC.

g. Provide all calculations, product data, and certifications, assessments, or validations required in this contract to demonstrate

compliance with the TPC Requirements of this section.

1.6.12.2 Third Party Certification (TPC) Documentation

Third Party Certification certificate, assessment, or validation, and compliance report requirements are in addition to all requirements under header above GUIDING PRINCIPLES VALIDATION (GPV).

1.6.12.2.1 TPC Already Registered

Project is already registered with TPC organization to achieve GBI DOD GP Compliance. When applicable, request TPC online access turnover from Government. Manage and provide all documentation for requirements of TPC and obtain Final Certification or validation. Third Party Certification is met when Government receives TPC organization certificate, assessment, or validation and compliance report.

1.6.12.2.2 TPC Management and Certification

Execute the following TPC Certification, assessment, or validation requirements:

a. Refer to TPC Checklist at the end of this specification section. (Multiple checklists indicate multiple buildings that require TPC.)

b. Immediately bring to the attention of the Contracting Officer any project changes that impact meeting the approved TPC Requirements for this project. Demonstrate the change will not increase the life-cycle cost and maintains or improves the building performance.

c. Complete all work required to incorporate the applicable TPC Requirements.

d. Maintain the construction related information in the Sustainability eNotebook pertaining to additions and changes to the approved sustainability requirements. When construction changes are made that affect design sustainability requirements, provide all required updates to affected design requirements and update in the Sustainability eNotebook. Maintain the Sustainability eNotebook in electronic format. For more explanation, refer to paragraph SUSTAINABILITY eNOTEBOOK. Provide the following components in the Sustainability eNotebook, in addition to the GPV components above:

(1) TPC Checklist

(2) Completed TPC forms. Transmit by the method required by the TPC organization.

(3) Copy of all correspondence with the TPC organization including proof of TPC registration

(4) Documentation illustrating compliance with TPC requirements and additional documentation as requested by the TPC

(5) TPC Award Certificate, assessment, or validation and compliance report.

e. Provide the following information in the Sustainability Action Plan. Provide this TPC information in addition to the Sustainability Action

Plan items above:

(1) Planned method to achieve each TPC requirement.

(2) 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.

(3) Provide name and contact information for: Sustainability point of contact (POC) and other names of sustainability professionals responsible for ensuring TPC sustainability goals are accomplished and documentation is assembled. Sustainability POCs are also responsible for ensuring GPV required in paragraph GUIDING PRINCIPLES VALIDATION (GPV) above.

f. 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 fees.

(2) Online (or offline with secure facilities) 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.

g. Provide all calculations, product data, and certifications, assessments, or validations required in this specification to demonstrate compliance with the TPC Requirements.

h. Provide all TPC management and documentation. Transmit TPC requirements by the method required by TPC organization.

i. Provide all required responses to third party organization.

j. Facilitate and participate in required TPC site visit. Coordinate with the Contract Officer to determine participating team members. Include Commissioning provider on applicable projects.

k. Provide TPC Certificate, assessment, or validation. Provide TPC compliance report that includes level achieved and reasons for non-compliance or not applicable elements. Use format below to create the Certificate, assessment or validation, compliance report, and Letter of Congratulations (when provided). Forward to parties designated by Contracting Officer:

(1) Certificate, Assessment or Validation:

Project Title, first line: P-(X); Form DD1391 Project Name).

Project Title, second line: UIC (Installation code)

(2) Letter Congratulations (when provided):

Address letter to Facility's Installation Commander Name. Address the letter to an individual person.

(3) 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.

l. Once Final Certification is achieved, turn over Administrative rights to online TPC to the Base Civil Engineer or designee, contact information provided by the Contracting Officer.

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

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 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.

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/EHLB/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 V1.1 (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)<br><br>**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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# Air Force Sustainability Requirements Scoresheet

## HPSB COMPLIANCE (Updated Jan 2017)

* required entry

**General Information**

Federal Requirements Complete

| | |
|---|---|
| FXBMTBD | Project ID (e.g. ABCD12345) |
| 000000000000000000 | Real Property Unique ID (RPUID) |
| B7504 | Facility Number |
| B-21:Weapons Loader Training Facility (WLT #1) | Building Name |
| Ellsworth AFB | Installation |
| Rapid City | City |
| SD | State |
| Yes | CONUS |
| ACC | MAJCOM |
| USACE | Construction Agent |
| TBD | AFCEC DM/CM (Last Name, First Name) |
| $15,000,000.00 | PA |
| 35,434 | Building Size (SF) |
| 2023 | Program Year (FY####) |
| Design Complete | Project Phase |
| 08/06/21 | Design Started (MM/DD/YY) |
| 04/07/23 | BOD (MM/DD/YY) |
| GBI GP | Guiding Principles Compliance Certification Method |
| 03/06/2023 | Date Project Registered (MM/DD/YY) |
| | Date Project Certified (MM/DD/YY) |
| 100% | HPSB Compliant |
| 13% | Energy Efficiency Achieved (% below ANSI/ASHRAE/IESNA Standard 90.1-2013) |
| 2017V1 | Scoresheet version |

# Air Force Sustainability Requirements Scoresheet

## HPSB COMPLIANCE (Updated Jan 2017)

* required entry

| Color Coding: See Instructions Tab for more detail | |
|---|---|
| Drop-Down Box | Yes or N/A |
| No Entry Required | No |
| Custom Entry | Recommended not Required |

**90.1-2013**

### HPSB I: Employ Integrated Design Principles (UFC 1-200-02 para 2-2)

Total Points **2** — Possible Points 2

| | | | |
|---|---|---|---|
| Yes | HPSB I.1 | **Integrated Design** | 1 |
| Yes | HPSB I.2 | **Commissioning** | 1 |

### HPSB II: Optimize Energy Performance (UFC 1-200-02 para 2-3)

Total Points **5** — Possible Points 5

| | | | |
|---|---|---|---|
| N/A | HPSB II.1 | **Energy Efficiency** | 1 |
| | | N/A — Reduce energy use 30% below ANSI/ASHRAE/IESNA Standard 90.1-2013 or IECC, or if not - achieve maximum energy efficiency that is lifecycle cost effective | |
| | | 13.0% — Insert percentage below ANSI/ASHRAE/IESNA Standard 90.1-2013 or IECC, in terms of energy use (e.g. 32) | |
| | | TBD — Insert building energy intensity (kBtu/yr-sqft) calculated IAW 10 CFR 433 | |
| | | N/A — **Roof Attributes (Recommended)** | |
| | | **Select roof types (Check below)** | |
| | | ☐ Cool roof ☐ Solar electric ☐ Solar Passive ☐ Green roof ☐ Solar thermal | |
| | | **Energy Efficient Products** — Yes | 1 |
| N/A | HPSB II.2 | **On-site Renewable Energy** | 1 |
| | | N/A — Installed renewable energy elements or projects were not lifecycle cost effective | |
| | | Renewable energy types (check below) | |
| | | ☐ Solar PV ☐ Geothermal ☐ Hydro ☐ Waste to Energy ☐ Solar CP ☐ GSHP ☐ Wind ☑ Renewables were not lifecycle cost effective ☐ Solar Thermal Electric | |
| | | 0.0 — Insert generation capacity (kW) | |
| | | 0.0% — Insert percentage of total building | |
| N/A | HPSB II.3 | **On-site Renewable Energy - Solar Hot Water Heater System** | 1 |
| | | N/A — Installed solar hot water heater system or found installation not lifecycle cost effective | |
| | | 0.0 — Insert generation capacity (MMBtu/yr) | |
| | | 0.0% — Insert percentage of demand | |
| Yes | HPSB II.4 | **Metering** | 1 |
| | | Yes — Electric Metering: Select N/A if no service | |
| | | Yes — Natural Gas Metering: Select N/A if no service | |
| | | N/A — Steam Metering: Select N/A if no service | |

### HPSB III: Protect and Conserve Water (UFC 1-200-02 para 2-4)

Total Points **6** — Possible Points 6

| | | | |
|---|---|---|---|
| Yes | HPSB III.1 | **Indoor Water** | 1 |
| Yes | | **Indoor Water Metering** | 1 |
| N/A | HPSB III.2 | **Outdoor Water** | 1 |
| N/A | | **Outdoor Water Metering** | 1 |
| N/A | HPSB III.3 | **Alternative Water** | 1 |
| N/A | HPSB III.4 | **Stormwater Management (LID Documentation per UFC 3-210-10)** | 1 |
| | | 0.0 — Change in Impervious Area (SF) | |
| | | $0.00 — Pre-Award Cost Estimate ($) | |
| | | N/A — Project addressed EISA 438 | |
| | | EISA Technical Constraints | |
| | | ☐ Retaining stormwater impact receving water flow ☐ Shallow bedrock, contaminated soil, high ground water table, underground utilities ☐ Soil infiltration capacity limited ☑ Site too small to infiltrate significant volume ☐ Non-potable water demand to small ☐ Structural, plumbing, and other mods not feasible ☐ State or local restrict water harvesting ☐ State or local restrict use of green ☐ Other | |
| | | 0.0% — Percent Increase in Stormwater Runoff for 95 Percentile Storm (%) - or- Percent Increase in Stormwater Runoff from continuous simulation model, published data, studies, or other established tools (Reference UFC 3-210-10 Figure 2-1 Implementation of EISA Section 438) | |
| | | Off-Site — LID Features Locations | |
| | | 0 — Integrated Management Practices Employed | |

# Air Force Sustainability Requirements Scoresheet

## HPSB COMPLIANCE (Updated Jan 2017)

* required entry

☐ Bio-Retention ☐ Dry Wells ☐ Filter Strips ☐ Grassed Swells
☐ Infiltration Trench ☐ Inlet Pollution Removal Device ☐ Permeable Pavement/Pavers ☐ Rain Barrels/Cisterns
☐ Soil Amendments ☐ Tree Box Filters ☐ Vegetated Buffers ☐ Vegetated Roof
☐ Other

| | |
|---|---|
| $0.00 | Final LID Construction Cost ($) |
| 0 | Post Construction Analysis (Name of DOR) |

| | | | |
|---|---|---|---|
| **HPSB IV: Enhance Indoor Environmental Quality (UFC 1-200-02 para 2-5)** | | | |
| Total Points | **8** | Possible Points | 8 |
| **Yes** | HPSB IV.1 | **Thermal Comfort** | 1 |
| **Yes** | HPSB IV.2 | **Ventilation** | 1 |
| **N/A** | HPSB IV.3 | **Daylighting** | 1 |
| **Yes** | HPSB IV.4 | **Moisture Control** | 1 |
| **Yes** | HPSB IV.5 | **Low Emitting Materials** | 1 |
| **Yes** | HPSB IV.6 | **Protect Indoor Air Quality during Construction** | 1 |
| **Yes** | HPSB IV.7 | **Environmental Tobacco Smoke Control** | 1 |
| **Yes** | HPSB IV.8 | **Occupant Health and Wellness** | 1 |
| **HPSB V: Reduce Environmental Impact of Materials (UFC 1-200-02 para 2-6)** | | | |
| Total Points | **5** | Possible Points | 5 |
| **Yes** | HPSB V.1 | **Recycled Content** | 1 |
| **Yes** | HPSB V.2 | **Biologically-based Products** | 1 |
| **Yes** | HPSB V.3 | **Ozone Depleting Substances** | 1 |
| **Yes** | HPSB V.4 | **Waste and Materials Management - Recycling** | 1 |
| **Yes** | HPSB V.5 | **Waste and Materials Management - Divert 60% from Disposal** | 1 |

| | |
|---|---|
| **Yes** | 60% or greater diverted |
| 60.0% | Insert percentage diverted from landfill |

| | | | |
|---|---|---|---|
| **HPSB VI: Address Climate Change Risk (UFC 1-200-02 para 2-7)** | | | |
| Total Points | **1** | Possible Points | 1 |
| **Yes** | HPSB VI.1 | **Address Climate Change Risk** | 1 |
| | | Possible Points | **27** |
| **27** | **Federal Requirements - Yes or N/A** | | |
| **0** | **Federal Requirements - No** | | |
| **100%** | **Percentage of Federal Requirements Met** | | |

| Federal Requirements for High Performance and Sustainable Buildings (HPSB) & UFC 1-200-02 | | | | |
|---|---|---|---|---|
| Instructions: Provide a common or project specific justification for an element to be non-applicable, when completed, the Scoresheet tab will allow an N/A response. | | | | |
| **Justification for Non-Applicable Answers** | | **Common Justification** | **Project Specific Justification** | **Complete?** |
| **HPSB I: Employ Integrated Design Principles (UFC 1-200-02, 2-2)** | | | | |
| HPSB I.1 | **Integrated Design** | | | Applicable |
| HPSB I.2 | **Commissioning** | | | Applicable |
| **HPSB II: Optimize Energy Performance (UFC 1-200-02, 2-3)** | | | | |
| HPSB II.1 | **Energy Efficiency** | Mission preclusion / Scope of work | | **Yes** |
| HPSB II.1 | **Energy Efficient Products** | | | Applicable |
| HPSB II.2 | **On-site Renewable Energy** | Mission Preclusion and Building/site issue | | **Yes** |
| HPSB II.3 | **On-site Renewable Energy - Solar Hot Water Heater System** | Not LCCE | | **Yes** |
| HPSB II.4 | **Metering** | | | |
| HPSB II.4 | Electric Metering: Select N/A if no service | | | Applicable |
| HPSB II.4 | Natural Gas Metering: Select N/A if no service | | | Applicable |
| HPSB II.4 | Steam Metering: Select N/A if no service | Location conditions | | **Yes** |
| **HPSB III: Protect and Conserve Water (UFC 1-200-02, 2-4)** | | | | |
| HPSB III.1 | **Indoor Water** | | | Applicable |
| HPSB III.1 | Indoor Water Metering: Select N/A if no service | | | Applicable |
| HPSB III.2 | **Outdoor Water** | Mission preclusion | | **Yes** |
| HPSB III.2 | Outdoor Water Metering: Select N/A if no service | Mission preclusion | | **Yes** |
| HPSB III.3 | **Alternative Water** | Location Conditions | | **Yes** |
| HPSB III.4 | **Stormwater Management** | | | |
| HPSB III.4 | Project addressed EISA 438 | Mission preclusion | | **Yes** |
| **HPSB IV: Enhance Indoor Environmental Quality (UFC 1-200-02, 2-5)** | | | | |
| HPSB IV.1 | **Thermal Comfort** | | | Applicable |
| HPSB IV.2 | **Ventilation** | | | Applicable |
| HPSB IV.3 | **Daylighting** | Mission preclusion | | **Yes** |
| HPSB IV.4 | **Moisture Control** | | | Applicable |
| HPSB IV.5 | **Low Emitting Materials** | | | Applicable |
| HPSB IV.6 | **Protect Indoor Air Quality during Construction** | | | Applicable |
| HPSB IV.8 | **Occupant Health and Wellness** | | | Applicable |
| **HPSB V: Reduce Environmental Impact of Materials (UFC 1-200-02, 2-6)** | | | | |
| HPSB V.1 | **Recycled Content** | | | Applicable |
| HPSB V.2 | **Biologically based products** | | | Applicable |
| HPSB V.3 | **Ozone Depleting Substances** | | | Applicable |
| HPSB V.4 | **Waste and Materials Management - Recycling** | | | Applicable |
| HPSB V.5 | **Waste and Materials Management - Divert 60% from Disposal** | | | Applicable |
| **HPSB VI: Adress Climate Change Riskd (UFC 1-200-02, 2-7)** | | | | |
| HPSB VI.1 | **Address Climate Change Risk** | | | Applicable |

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# Department of Defense
# Guiding Principles Compliance for
# New Construction & Comprehensive Replacement
# Scoping Checklist

**Instructions**

This DOD GPC NC Scoping Checklist is for use during the planning stage to identify all goals for the project to meet the requirements set forth in UFC 1-200-02 High Performance and Sustainable Building Requirements and the Guiding Principles for Sustainable Federal Buildings.

Refer to UFC 1-200-02 for the full text of each element. After identifying requirements that are not applicable to the project (see Answer Selections below), the remaining elements must all be met, including partial compliance (with percentages) and non-applicables.

This DOD review is in alignment with UFC 1-200-02 for the purposes of this validation. "Guiding Principles" are met when the requirements of UFC 1-200-02 are met.

**UFC Applicability**
UFC 1-200-02 High Performance and Sustainable Building Requirements is effective for all projects. To obtain the latest version of UFC 1-200-02, visit the Whole Building Design Guide's web page:

**http://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc/ufc-1-200-02**

Projects that have a delay - either planned or unintentional - of more than 18 months between design completion and the solicitation of offers for construction must be re-evaluated to determine if any design revision is necessary due to changes in criteria (including codes and standards) or site infrastructure (e.g. water supply for fire department vehicle access).

**DOD GPC NC Program Applicability**

GBI's DOD GPC NC program applies to new construction and comprehensive replacement that require addition of Third Party Certification (TPC) (as described in UFC 1-200-02, Table 1-1) per one of the following:

☐ New building or stand-alone addition ≥10,000 GSF, with construction cost >$3M.
OR
☐ Comprehensive replacement* in an existing building that is ≥10,000 GSF, with total cost >$3M, and 50% or more enhanced replacement cost (ERC). *Note that all three thresholds must be met to require TPC for a comprehensive replacement project.*

*Comprehensive replacement to a building includes significant opportunities for improvement in: energy and water efficiency (such as HVAC, lighting, building envelope, and other building components); indoor air quality, other requirements in UFC 1-200-02; and additions that are part of the comprehensive replacement.

Total cost for comprehensive replacement includes addition, operations and maintenance, sustainment, restoration, and modernization associated with an existing building comprehensive replacement.

To inquire about an existing building project, please contact GBI at (503) 274-0448 or info@thegbi.org to determine eligibility.

**Answer Selections:**
"Yes" means an element will be fully achieved, or highest resource efficiency achieved, with Life-Cycle Cost Analysis (LCCA) supporting documentation (when applicable).

Per UFC 1-200-02, "partially compliant" means:

*"the requirement is compliant to the greatest degree possible, based on LCCE (e.g., SDHW serves only 20% of water use, per LCCE); mission restriction (e.g., 24/7 operation); location/regional restriction (e.g., availability of high-efficiency equipment service); or locale restriction (e.g., proximity of existing buildings restricts daylighting), or safety (example: building orientation restriction for anti-terrorism due to existing infrastructure), and is marked 'Yes' with justification."*

**"Not Applicable" ("N/A")** is to be used only when:
**Mission** precludes the element (e.g. facility mission prohibits the use of windows);
**Location of installation** restricts or precludes achievement of element (e.g. there is no local recycling);
**Location conditions** mean that the element is not part of the project (e.g. there is no meter for steam because there is no steam);
**Safety** (e.g. building orientation restriction for anti-terrorism due to existing infrastructure); or
**LCCA does not support** any compliance with this requirement.

**Justification must be provided during third-party assessment for each element marked "N/A", including any LCCA supporting partial compliance (based on a percentage) or no compliance to a requirement.**

Unless otherwise noted, all line items must be indicated. If a choice has not been selected, include a note. The project's achievement from third-party assessment will not be negatively impacted as a result of indicating "N/A," or where LCCA supports partial compliance (with percentages) or no compliance to a requirement. The intent is for the project team to determine during the design stage if any of the Guiding Principles (UFC 1-200-02 requirements) are not applicable, and that the remaining requirements must be fully met including partial compliance with LCCA.

| UFC, UFGS, and ASHRAE Applicability | | |
|---|---|---|
| **Applicable ASHRAE Standards** | | |
| ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings | Link | Yes |
| 2018 International Green Construction Code (IgCC) | Link | Yes |
| **Applicable Unified Facilities Criteria (UFC)** | | |
| UFC 1-200-02 High Performance and Sustainable Building Requirements | Link | Yes |
| UFC 2-100-01 Installation Master Planning | Link | Yes |
| UFC 3-101-01 Architecture | Link | Yes |
| UFC 3-201-01 Civil Engineering | Link | Yes |
| UFC 3-201-02 Landscape Architecture | Link | Yes |
| UFC 3-210-10 Low Impact Development | Link | Yes |
| UFC 3-410-01 Heating, Ventilation, and Air Conditioning Systems | Link | Yes |
| UFC 3-440-01 Facility-Scale Renewable Energy Systems | Link | Not Applicable - Mission Preclusion and Building/site issue |
| UFC 3-530-01 Interior and Exterior Lighting Systems and Controls | Link | Yes |
| UFC 4-010-06 Cybersecurity Of Facility-Related Control Systems | Link | Yes |
| UFC 4-510-01 Design: Military Medical Facilities | Link | Not Applicable - Mission Preclusion |
| **Applicable Unified Facilities Guide Specifications (UFGS)** | | |
| UFGS 01 33 29 Sustainability Requirements and Reporting | Link | Yes |
| **ARMY/USACE executed projects:** UFGS 01 45 00.00 10 Quality Control | Link | Not Applicable - Air Force project |
| **Navy/NAVFAC executed projects:** UFGS 01 45 00.00 20 Quality Control | Link | Not Applicable - Air Force project |
| UFGS 01 74 19 Construction Waste Management and Disposal | Link | Yes |
| UFGS 01 78 00 Closeout Submittals | Link | Yes |
| UFGS 01 78 23 Operation and Maintenance Data | Link | Yes |
| **Army/USACE executed projects:** UFGS 01 91 00.15 10 Total Building Commissioning | Link | Yes |
| **Navy/NAVFAC executed projects:** UFGS 01 91 00.15 20 Total Building Commissioning | Link | Not Applicable - Air Force project |
| UFGS 23 08 00.00 20 Commissioning of Mechanical [And Plumbing] Systems | Link | Not Applicable - Air Force project |

| i. LIFE-CYCLE COST ANALYSIS (LCCA) | | Notes and Justifications |
|---|---|---|
| **i.a LCCA Format** | | |
| i.a.1 UFC 1-200-02: Life-Cycle Cost Analysis (LCCA) | *Partially* | Partially not Applicable - Mission Preclusion and Building/site issue |

| 1 EMPLOY INTEGRATED DESIGN PRINCIPLES | | Notes and Justifications |
|---|---|---|
| **1.a Integrated Design** | | |
| 1.a.1 UFC 1-200-02: Integrated Design | *Yes* | |
| 1.a.2 UFC 1-200-02: Integrated Planning | *Yes* | |
| 1.a.3 UFC 1-200-02: Evaluation for Design Strategies | *Yes* | |
| 1.a.4 UFC 1-200-02: Evaluation of the Site | *Not Applicable* | Not Applicable - Site is already selected per the 1391 |
| 1.a.5 UFC 1-200-02: Site Integration and Design of the Building | *Yes* | |

| | | |
|---|---|---|
| **1.b Commissioning** | | |
| 1.b.1 UFC 1-200-02: Commissioning | *Yes* | |
| **2 OPTIMIZE ENERGY PERFORMANCE** | | **Notes and Justifications** |
| **2.a Energy Efficiency** | | |
| 2.a.1.A UFC 1-200-02: Commercial and Multi-Family High-Rise Residential Buildings | *Partially* | Mission preclusion / Scope of work - Currently achieving 13% energy efficiency |
| 2.a.1.B UFC 1-200-02: Low-Rise Residential Buildings | *Not a Low-Rise Residential Building* | |
| 2.a.1.C UFC 1-200-02: Comprehensive Replacement and SRM | *Not a Comprehensive Replacement or SRM Project* | |
| 2.a.2 UFC 1-200-02: Energy Efficient Products | *Yes* | |
| 2.a.3 UFC 1-200-02: Standby Powered Devices | *Yes* | |
| **2.b Onsite Renewable Energy** | | |
| 2.b.1 UFC 1-200-02: On-Site Renewable Energy | *Not Applicable* | Not Applicable - Mission Preclusion and Building/site issue |
| 2.b.2 UFC 1-200-02: Solar Domestic Hot Water (SDHW) | *Not Applicable* | Not Applicable - Mission Preclusion and Building/site issue |
| **2.c Metering** | | |
| 2.c.1 UFC 1-200-02: Metering | *Yes* | |
| **3 PROTECT AND CONSERVE WATER** | | **Notes and Justifications** |
| **3.a Indoor Water Use** | | |
| 3.a.1 UFC 1-200-02: Indoor Water | *Yes* | |
| 3.a.2 UFC 1-200-02: Indoor Water Metering | *Yes* | |
| **3.b Outdoor Water Use** | | |
| 3.b.1 UFC 1-200-02: Landscaping | *Not Applicable* | Not Applicable - Mission preclusion |
| 3.b.2 UFC 1-200-02: Outdoor Water Metering | *Not Applicable* | Not Applicable - No permanent irrigation provided |
| **3.c Alternative Water** | | |
| 3.c.1 UFC 1-200-02: Alternative Water | *Not Applicable* | Not Applicable - Location Conditions |
| **3.d Stormwater Management** | | |
| 3.d.1 UFC 1-200-02, 2-4.4 Stormwater Management | *Yes* | |
| **4 ENHANCE INDOOR ENVIRONMENTAL QUALITY** | | **Notes and Justifications** |
| **4.a Ventilation and Thermal Comfort** | | |
| 4.a.1 UFC 1-200-02: Ventilation and Thermal Comfort | *Yes* | |
| **4.b Daylighting and Lighting Controls** | | |
| 4.b.1 UFC 1-200-02: Daylighting and Lighting Controls | *Not Applicable* | Not Applicable - Mission preclusion |
| **4.c Indoor Air Quality** | | |
| 4.c.1 UFC 1-200-02: Moisture Control | *Yes* | |
| 4.c.2 UFC 1-200-02: Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials) | *Yes* | |
| 4.c.3 UFC 1-200-02: Protect Indoor Air Quality during Construction | *Yes* | |
| 4.c.4 UFC 1-200-02: Environmental Tobacco Smoke Control | *Yes* | |
| ***** Occupant Health and Wellness** | | |
| *** UFC 1-200-02: Occupant Health and Wellness<br>*(Covered by 1.a.5 UFC 1-200-02: Site Integration and Design of the Building)* | | |

| 5 REDUCE ENVIRONMENTAL IMPACT OF MATERIALS | | Notes and Justifications |
|---|---|---|
| **5.a Material Content and Performance** | | |
| 5.a.1 UFC 1-200-02: Recycled Content | *Yes* | |
| 5.a.2 UFC 1-200-02: Biologically-Based Products | *Yes* | |
| 5.a.3 UFC 1-200-02: Ozone Depleting Substances | *Yes* | |
| **5.b Waste Diversion and Materials Management** | | |
| 5.b.1 UFC 1-200-02: Storage of Recyclables | *Yes* | |
| 5.b.2 UFC 1-200-02: Waste Diversion | *Yes* | |

| 6 ASSESS AND CONSIDER CLIMATE CHANGE RISKS | | Notes and Justifications |
|---|---|---|
| **6.a Address Climate Change Risks** | | |
| 6.a.1 UFC 1-200-02: Address Climate Change Risk | *Yes* | |

## NEXT STEPS

**Third-Party Guiding Principles Compliance Assessment**

For third-party assessment of compliance to Guiding Principles, contact Green Building Initiative (GBI) at 503.274.0448. Registering and ordering a third-party assessment from GBI allows access to the DOD GPC NC Survey and Technical Reference Manual. Each Department of Defense GPC NC assessment includes a third-party review of the completed DOD GPC NC Survey and supporting documentation as part of the 100% Design Submittal phase, as well as two options for the final assessment: Onsite Assessment or Post-Construction Document Review. Supplementary reviews can be purchased for an additional fee if the team prefers to have a document review prior to 100% submittals.

**Contact GBI to get started: 503.274.0448**


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SECTION 01 33 39.00 10

ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS
**12/17**

PART 1 GENERAL

This project requires delivery of BIM, CIM, GIS, and CAD deliverables during the Construction phase of the project. This specification defines the content and formatting standards by which those deliverables shall conform.

While this specification is not intended to identify all required advanced modeling submittals or deliverables, it defines the content and formatting standards by which those items must conform. See 01 78 24.00 10 FACILITY DATA REQUIREMENTS and 01 78 39.00 24 AS-BUILT DRAWINGS for deliverable requirements.

All advanced modeling products and deliverables required by this contract shall comply with the applicable provisions herein.

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 ORGANIZATION FOR STANDARDIZATION (ISO)

| | |
|---|---|
| ISO 19005-3 | (2012) Document Management -- Electronic Document File Format for Long-Term Preservation -- Part 3: Use of ISO 32000-1 with Support for Embedded Files (PDF/A-3) |
| ISO 32000-1 | (2008) Document Management -- Portable Document Format -- Part 1: PDF 1.7 |

NATIONAL INSTITUTE OF BUILDING SCIENCES (NIBS)

| | |
|---|---|
| NBIMS-US | (V3) National BIM Standard - United States |
| NCS | (V6) United States National CAD Standard |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 1110-1-2909 | (2012) Geospatial Data and Systems |
| ERDC/ITL TR-12-1 | (2019) A/E/C Graphics Standard, Release 2.1 |
| ERDC/ITL TR-12-6 | (2019) A/E/C CAD Standard - Release 6.1 |

1.2 DEFINITIONS

1.2.1 Advanced Modeling

A subset of geospatial technologies as defined EM 1110-1-2909 GEOSPATIAL

DATA AND SYSTEMS to include BIM, CIM, GIS, and CAD. Models and drawings that form a digital representation of the project, or part thereof, comprised of "Model Elements" with "Facility/Site Data."

1.2.2 Facility/Site Data

The non-graphical information attached to objects in the Model that defines various characteristics of the object. Facility/Site Data can include properties such as parametric values that drive physical sizes, material definitions and characteristics (e.g. wood, metal), manufacturer data, industry standards (e.g. AISC steel properties), and project identification numbers. Facility/Site Data can also define supplementary physical entities that are not shown graphically in the Model, such as the system of a duct, hardware on a door, content of conduit, or transformer properties.

1.2.3 Model

A digital, graphical or non-graphical, representation of a facility to be used during that facility's lifecycle. A model is composed of model elements and other supporting data to address the intended "model use" or uses.

1.2.4 Model Element

A self-contained element with a unique identification, whose behavior and properties are defined by Facility/Site Data and software processes. Model Elements can represent a physical entity, such as a pump, a concrete wall, or a utility vault and range from the simple to the complex.

1.2.5 Model Uses

Reference NBIMS-US. A Model Use is a method or strategy of applying modeling during a facility's life cycle to achieve one or more specific objectives.

1.2.6 Record Model

A model reflecting all approved changes during construction including red-lines, requests for information (RFIs), and contract modifications. Includes updated construction phase facility/site data for all components.

1.2.7 USACE BIM/CIM Platform Configuration Standards - Templates, Workspaces, Catalogs, and Environments

1.2.8 USACE CAD/BIM Technology Center

The USACE CAD/BIM Technology Center hosts all standard advanced modeling content for USACE. This content can be accessed through the CAD/BIM Technology Center website, https://cadbimcenter.erdc.dren.mil/.

1.2.9 Working Construction Model

Working model created and updated during construction which incorporate the changes received during construction to including red-lines, requests for information (RFIs), and contract modifications at intervals during the construction process. These include updated construction phase

facility/site data for installed components.

## 1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation. Submittals not having a "G" designation are for information only. When used, a designation following the "G" designation 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

Advanced Modeling Project Execution Plan (PxP); G, DO

PxP Demonstration

## 1.4 QUALITY ASSURANCE

### 1.4.1 Advanced Modeling Project Execution Plan (PxP)

Develop an Advanced Modeling Project Execution Plan ("Plan" or "PxP") documenting mandatory and Contractor-elected BIM Uses, analysis technologies, and workflows.

Submit the PxP within forty-five (45) days after Notice to Proceed.

Contractors shall use the USACE ADVANCED MODELING (BIM) PROJECT EXECUTION PLAN (PxP) Template located at the USACE CAD/BIM Technology Center website to develop an acceptable plan to include platforms and processes.

#### 1.4.1.1 Minimum Modeling Matrix (M3)

The USACE Minimum Modeling Matrix (M3) describes the minimum modeling and data requirements by defining the Level of Development ("LOD") and Element Grade. Contractors shall use the M3 Template located at https://cadbimcenter.erdc.dren.mil/ and submit as part of the PxP.

Per instructions in the M3, Contractor is to identify elements included in the project scope and provide any applicable comments

#### 1.4.1.2 Advanced Modeling PxP as Living Document

The Contractor shall maintain the PxP to reflect advanced modeling practices, procedures, and methods of compliance throughout the duration of the Project. Resubmit the PxP to the Government for approval if changes alter method of contract compliance. Updates and revisions to the PxP that do not significantly alter contents and/or method of compliance need not be submitted for approval.

#### 1.4.1.3 Model Uses

Include all of the following Model Uses in the PxP.

##### 1.4.1.3.1 Mandatory Model Uses

The following Model Uses are mandatory:

1.4.1.3.1.1 Construction Phase Mandatory Model Uses

a. 3D Coordination
b. Record Modeling

1.4.1.3.2 Optional Model Uses

Contractor may use or pursue other Model Uses as desired. Also document these uses in the PxP.

1.4.2 PxP Demonstration

See PxP Demonstration meeting requirements described in "Meetings" paragraph below.

1.4.3 Meetings

1.4.3.1 Pre-Construction Meeting

At minimum discuss the following during the meeting:

a. The requirement for Advanced Modeling deliverables under this Contract.

b. Primary roles and responsibilities associated with the development and delivery of the Advanced Modeling submittals under this Contract.

c. Identify and agree upon a date and attendance list for the meetings described below:

1.4.3.2 Advanced Modeling Kick-Off Meeting

Conduct an Advanced Modeling Kick-Off Meeting prior to submission of the PxP, within forty-five (45) days after Notice to Proceed. This meeting must include, at a minimum, the Contractor and the Geographic District BIM Manager or delegate.

The intent of this meeting is to coordinate the Government's and the Contractor's expectations for the Advanced Modeling PxP.

1.4.3.3 PxP Demonstration Meeting

Within thirty (30) days after the acceptance of the PxP and M3, conduct a demonstration to review the Plan for clarification, and to verify the functionality of planned Model technology workflow and processes. If modifications are required, the Contractor shall complete the modifications and resubmit the PxP performing a subsequent demonstration for Government acceptance. There will be no payment for design or construction until the PxP is completed and accepted by the Government. The Government may also withhold payment for unacceptable performance in executing the accepted PxP.

1.4.3.4 Preparatory Phase Review and Meetings

Include review of the working 3D coordination model as part of preparatory phase procedures defined in 01 45 00.00 10 QUALITY CONTROL.

## 1.5 OWNERSHIP AND RIGHTS OF DATA

The Government has ownership of and rights at the date of Closeout Submittal to all CAD files, BIM/CIM Model(s), and Facility/Site Data developed for the Project in accordance with FAR Part 27, clauses incorporated in Section 00 72 00, GENERAL CONDITIONS (Contract Clauses) and Section 00 73 00 SPECIAL CONDITIONS Special Contract Requirement 1.14 GOVERNMENT RE-USE OF DESIGN. The Government may make use of this data following any deliverable.

## 1.6 DELIVERY, STORAGE, AND HANDLING

Deliver Advanced Modeling submittals in an organized and legible manner. Provide submittals adhering to the requirements described below.

### 1.6.1 Advanced Modeling Submittal Packaging

When a project specification requires advanced modeling deliverables, provide the following documents and files in support of those advanced modeling deliverables. Submission of items listed below shall not limit compliance with deliverable and submittal requirements in those respective specifications. Submit all advanced modeling deliverables electronically, media and/or method as indicated in this Contract. Provide number of copies of electronic media (if required) as described below:

#### 1.6.1.1 Approved PxP

Provide an electronic copy of the most current approved version of the project Advanced Modeling PxP.

#### 1.6.1.2 List of Submitted Files

Provide an electronic list (.txt file or similar) of all submitted electronic files including a description, directory, and file name for each file submitted. Identify which files have been produced from the Model and Facility Data. For all Sheet files, include a list of the sheet titles and sheet numbers.

#### 1.6.1.3 Advanced Modeling Electronic Files

Provide all native advanced modeling files associated with the production of the advanced modeling deliverable. Update and maintain in compliance with the advanced modeling formatting, content requirements, and standards as defined by this specification, in order to yield a complete and coordinated document set.

#### 1.6.1.4 Facility Data Deliverables

Provide all electronic facility data deliverables in the format(s) described in this and referenced specification(s).

#### 1.6.1.5 CAD Exports of BIM-Generated Sheets and Drawings

Provide supplemental 2D CAD exports of all contract drawing sheets from the project BIM model. Export all contract drawing sheets to the CAD format(s) defined in this specification.

1.6.1.6 GeoDataBase Files

Provide a SDSFIE/FGDC GeoReferenced personal GeoDataBase.

For all information outside of the building walls, the Contractor shall provide a personal GeoDatabase in .mdb format using the latest version of Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) as the database structure. Provide a shell database to define the projection and database structure.

For all drawings within and including the exterior walls, the Contractor shall utilize the advanced modeling formats described and referenced herein.

Provide a short GeoDataBase read-me file explaining the deliverable. The read-me file shall include a description of the software used to create the data, projection, and include the attribute tables used.

1.6.1.7 QC Reports

Provide electronic PDFs of all QC reports and checks utilized to ensure full compliance with the contract requirements and standards:

1.6.1.7.1 Model Standards Checks and Reports

Provide QC checks demonstrating adherence to the NCS "BIM Implementation" section. Verify that the Project Facility/Site Data set has no undefined, incorrectly defined or duplicated elements. Identify and report non-compliant elements and submit a corrective action plan. Provide the Government with detailed justification and request Government acceptance for any non-compliant element that the Contractor proposes to be allowed to remain in the Model.

a. No errors when opening.

b. No broken Links, References, or X-References.

c. Minimized extraneous information.

d. Content uses the coordinate system defined in the approved PxP.

e. Models share a common alignment point.

f. Each discipline identified in the approved PxP is represented.

1.6.1.7.2 Graphics Standards Checks and Report

Provide QC checks on all graphic deliverables demonstrating that the fonts, dimensions, symbology and other construction document formatting are compliant with the requirements of this specification. Identify and report non-compliant content.

1.6.1.7.3 CAD Standards Checks and Report

Provide QC checks on CAD Output demonstrating that filenames, sheet borders, layer/level names, and symbology are compliant with the requirements of this specification. Identify and report non-compliant content. Identify and report non-compliant content.

1.6.1.7.4 Other Parameters

Develop such other QC parameters as Contractor deems appropriate for the Project and provide to the Government for acceptance.

1.6.1.8 PDF Documents

Provide one PDF file of design documents per discipline and one additional PDF file combining all disciplines, following the A/E/C CAD Standard discipline and drawing order. Bookmark PDF files in compliance with bookmarking requirements described in 01 78 24.00 10 FACILITY DATA REQUIREMENTS.

1.6.1.9 Advanced Modeling Re-Submittals

If components of an as-built submittal are rejected, provide the following for each re-submittal, in addition to information required by 01 33 00 SUBMITTAL PROCEDURES:

a. Re-submit all components required under paragraph ADVANCED MODELING SUBMITTAL PACKAGING, including a new Advanced Modeling Checklist and updated content in response to Government comments.

b. Provide a copy of all Government review comments.

c. Provide a response to each Government review comment for back check.

1.6.2 Number of Copies

Provide three identical copies of disks for approval, for each submittal and each facility required. Provide on approved electronic media (one copy per disk or set of disks) as defined below. Provide submittal files on electronic storage media in compliance with the quality requirements identified in this specification.

1.6.3 Malicious Content

Scan all files for malicious viruses using commercially available scanning program that is routinely updated to identify and remove current virus threats.

1.6.4 Storage Media

Provide facility data on disk-based (DVD-R/RW) media. Any deviations from the required storage media must be approved by the Government. Select and apply technology used for electronic data transmission to ensure that the full submittal is provided on one single disk, whenever possible. When separation of the submittal is required separate the each site or facility onto separate media. Any further divisions must be documented in the PxP and approved by the Government.

1.6.4.1 Disk-Based Media

a. Apply a label directly printed to storage media. Do not provide adhesive, paper-based labels. List the name of the facility, project, project location, Contract number, Designer of Record firm/Prime Contractor company's name, title of submission, and security

classification (in accordance with the appropriate security classification labeling regulations) on the label. If multiple disks are provided, clearly document the contents of each disk on the label.

b. Include the name and contact information of the individual who produced the final data disk to ensure that any problems with the data or media can be easily resolved.

c. When browsed on any computer, the disk must display the following folders and their associated content:

(1) Submittal XXXXXX-X.X (Containing all submittal data)
(2) PxP (Containing 1 PxP per contract)
(3) Readme (Containing 1 TXT, PDF, or HTML file with general use information, organizational instructions, and basic preparer contact information. Include all information included on the storage media label.

### 1.6.5 Protection of GIS Data

GIS source data and product data remain the property of the US Government. The contractor may be required to explain and demonstrate the company's process for protecting all geospatial data, including but not limited to geometry, attributes, metadata, topologies, and relational database schemas and operations used in association with this contract. The contractor may be required to sign a non-disclosure agreement attesting to the same before source data are released. Further information about security and nondisclosure requirements should be obtained from the COR. Some installation map data, source and/or product, may be considered by the government to be "Controlled Unclassified Information" (CUI) also known as "Sensitive but Unclassified" (SBU). The contractor is not authorized to release this information to any third party without the explicit consent of the COR. All source information must be returned to the Government or destroyed upon completion of this contract.

## PART 2 PRODUCTS

### 2.1 GOVERNMENT FURNISHED MATERIALS

The Government will provide advanced modeling files as Government Furnished Material (GFM) for the Contractor's use in developing Record Drawings and/or As-Builts defined in 01 78 39.00 24 AS-BUILT DRAWINGS. The information and level of detail contained in the GFM shall be maintained in the Record Models and Record CAD files. The record CAD files are to be derived from the record models.

The Contractor has the option of preparing their own BIM/CIM models and CAD drawings in lieu of utilizing GFM. Such drawings and models will also be held to the deliverable and quality requirements described herein.

### 2.1.1 GFM Handover

The Government will provide the GFM, upon request, after contract award. Proposing contractors may request access to the GFM (without amendments) during soliciation, for evaluation and assessment. If issued prior to award, files are for information only, and do not serve as contract documents.

The Contractor is responsible for reviewing the GFM and, if the Contractor

chooses to use the GFM, maintaining the files in compliance with the this specification.

2.1.2 GFM File Formats

GFM will be provided in the following file formats:

2.1.2.1 Government Furnished BIM

The GFM will include Autodesk Revit 2020 files, with some linked Autodesk AutoCAD (.dwg) files.

2.1.2.2 Government Furnished CIM

The GFM will include Autodesk AutoCAD Civil 3D files.

2.1.2.3 Government Furnished GIS

Government will provide Ellsworth Air Force Base's most current Standard GIS Database Template to the Contractor. Documentation of the required attributes and schema definitions will be provided with the Standard GIS Database Template.

2.1.2.4 Government Furnished CAD

Aside from linked Revit CAD files, the GFM will include Autodesk AutoCAD files.

2.1.3 Variation with Contract Drawings

The Government makes no claim or warranty that any of the GFM are complete or fully consistent with the contract drawings. The digital files provided are not part of the contract documents. If there is any discrepancy between the BIM/CIM models, the CAD drawings, and the contract drawings, the contract drawings shall govern. The Government has no responsibility to modify any GFMs due to changes in the design that occur after award, and the Government shall assume no liability for the contents of the files provided.

Evaluate the content and quality of the GFM upon receipt. If major discrepancies or omissions occur in the GFM, notify the Contracting Officer and indicate the nature of such variation(s).

2.1.4 Model Completion and Quality for Record Drawings and/or As-Builts

The Government makes no guarantee that the Record Drawings and/or As-Builts GFM files are developed to the level of completeness or quality required for submittals described herein. It is the Contractor's responsibility to maintain the provided files in compliance with requirements described herein, but shall not be held responsible for bringing baseline GFM into full compliance.

2.1.5 Data Loss, Corruption, and Error

Transfer of GFM files to the Contractor may result in corrupted files resulting in data loss and/or errors. Use of GFM files is at the Contractor's risk. Verify data integrity upon receipt and request a replacement if necessary.

Any adjustment of file structure, format, or software version required to make GFM compatible with the Contractor's computer systems and/or software is the responsibility of the Contractor.

## 2.2 SYSTEM PLATFORM AND FILE FORMATS

The Contractor shall use the BIM, CIM, GIS, and CAD application(s), software(s), and file format(s) described below:

### 2.2.1 BIM

The BIM submittal formats shall be Autodesk Revit 2020 or later, with Autodesk AutoCAD 2013 or later (.dwg) files. The BIM submittals shall be fully operable, compatible, and editable within the native BIM/CIM tools.

### 2.2.2 CAD Exports of BIM-Generated Sheets and Drawings

Provide supplemental 2D CAD exports from the project BIM model. Export all contract drawing sheets in Autodesk AutoCAD 2013 or later (.dwg) format.

### 2.2.3 CIM

The CIM submittal format shall be Autodesk Civil 3D 2019 or later (.dwg). The CIM submittals shall be fully operable, compatible, and editable within the native BIM/CIM tools.

### 2.2.4 GIS

All GIS databases shall be submitted in Environment Systems Research Institute's(ESRI) ArcGIS compatible file formats.

### 2.2.5 CAD

The CAD submittal format shall be Autodesk AutoCAD 2013 or later (.dwg) format.

### 2.2.6 Facility Data Requirements

This contract contains requirements for collection, organization, and turnover of electronic Facility Data deliverables. Provide Facility Data under the the following content and formatting standards:

#### 2.2.6.1 Facility Data Workbook (FDW)

Provide complete Facility Data Workbook(s) and Facility Document Set(s) in compliance with 01 78 24.00 10 FACILITY DATA REQUIREMENTS.

Coordinate Facility Data requirements with Advanced Modeling requirements and document in the Advanced Modeling PxP as appropriate.

### 2.2.7 Other Formats

#### 2.2.7.1 PDF

Utilize PDF file format in accordance with ISO 32000-1 and ISO 19005-3. Provide files from original sources, text-searchable, and saved in "Standard" (uncompressed) resolution whenever possible.

PART 3 EXECUTION

3.1 ADVANCED MODELING REQUIREMENTS

3.1.1 BIM and CIM

All BIM and CIM content authoring, model coordination, content delivery and all other activities and products shall comply with the NCS BIM Implementation section, part "3.0 Basic BIM Guidelines."

All CAD content produced within the BIM and CIM authoring platforms shall comply with the NCS BIM Implementation section, part "2.0 Clarifications."

3.1.1.1 Minimum Modeling Requirements

Model to the requirements of the USACE Minimum Modeling Matrix(M3). The contractor shall not be held to improve the modeling quality of the GFM outside of modifications, revisions, and/or redlines; any additions, refinements, and/or revisions to the GFM shall comply.

3.1.1.2 USACE Software Configuration Standards

a. Develop the project using USACE Bentley Workspace (version contained in GFM).

b. Develop the project using USACE Revit Templates (version contained in GFM).

3.1.1.3 Classification

All modeled elements shall include Facility/Site Data referencing one or more classification system(s) identified in the M3.

3.1.1.4 Space/Room Data

The Model shall include spatial data defining actual net square footage and data to develop the room finish schedule, including room names and numbers. Include program information to verify design space against programmed space, using this information to validate area quantities.

3.1.1.5 Coordinate System

a. State Plane Coordinate System: South Dakota
b. Units: Imperial Survey Feet
c. Horizontal Datum: NAD 83
d. Vertical Datum: NAVD 88

See the survey sheets ("VF" sheets) in design drawings for additional information.

3.1.1.6 Schedules

Schedules shall comply with the NCS BIM Implementation section, part "2.4 Schedules." Schedules shall be produced from, and remain linked to, the Facility/Site Data within the Model. Any exceptions must be documented in the PxP and submitted to the Geographic BIM Manager, or delegate, for review.

3.1.1.7 Details and Enlarged Sections

Details and enlarged sections shall comply with the NCS BIM Implementation section, part "3.2 Model Coordination and Delivery." All details and enlarged sections necessary for construction shall be derived from the Model when possible. For those details and enlarged sections not derived directly from the Model, Contractor must verify that geometry and data depicting the details and enlarged sections are consistent with Model elements. Details with significant drafted content such as 'standard' and 'typical' details shall not contradict the model and shall utilize the model as an underlay when possible for the purposes of verification and coordination. Three dimensional, isometric, and section isometric details derived from the model are preferred.

3.1.1.8 Drawing Indices

Drawing indices shall comply with the NCS BIM Implementation section, part "2.3 Sheet Organization." Where BIM authoring platform supports it, drawing indices should be derived from a model-driven schedule.

3.1.1.9 CAD Export

CAD content exported from a BIM or CIM modeling platform shall comply with the NCS BIM Implementation section, part "2.0 Clarifications."

CAD file format and version shall be as indicated in the "CAD" paragraph below.

3.1.2 GIS

3.1.2.1 Minimum Modeling Requirements

Provide final geo-referenced GIS database of the new building footprint, and site surface and subsurface features that exist outside the building footprint(s) out to the project extents.

Contractor shall collect GIS geo-referenced data pertaining to location and attribute data of subsurface utilities obtained at the time of project site excavation. All data collection for underground utilities shall include the collection of elevation (Z) values.

3.1.2.2 Standard GIS Database Template

The Contractor must use the Standard GIS Database Template provided by Installation Geospatial Support Office to produce the GIS deliverables required under this contract.

3.1.3 CAD

All CAD content produced through native CAD authoring software outside of any BIM or CIM platform shall be compliant with ERDC/ITL TR-12-6 A/E/C CAD Standard and ERDC/ITL TR-12-1 A/E/C Graphic Standard.

3.1.3.1 USACE Software Standards

a. Autodesk AutoCAD Template Files. Download form the CAD/BIM Technology Center website as part of the A/E/C Work Structure.

3.2 FINAL DESIGN AND FINAL RECORD SUBMITTAL REQUIREMENTS

Follow requirements for Content Delivery from the NCS BIM Implementation section, part "3.0 Basic BIM Guidelines."

3.3 AS-BUILT ADVANCED MODELING REQUIREMENTS

See Section 01 78 39.00.24 AS-BUILT DRAWINGS for additional as-built and record model quality and deliverable requirements. Deliverable requirements listed in that specification shall not preclude development of the project in BIM/CIM/GIS/CAD through construction as required herein.

3.4 Waivers of Specific Requirements

If a requirement contained in this document can not be achieved, or can not be achieved at a cost commensurate with the value of the requirement, the Contractor may request, in writing, that the requirement be withdrawn or modified. The request must certify that the Contractor has diligently attempted to meet the requirement, that the requirement can not reasonably be met, and that alternative approaches meet the intent of the requirement. The request must be supported by evidence of the Contractor's research and documentation that the alternative approach meets the function and interoperability requirements of this document. The Government, in its sole discretion, may waive requirements found to be currently unachievable or not commercially practicable.

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GOVERNMENTAL SAFETY REQUIREMENTS

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GOVERNMENTAL SAFETY REQUIREMENTS
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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.

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 | (2020) 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 | (2021) 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 | (2020) 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 |

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 FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 10 | (2022; ERTA 1 2021) Standard for Portable |

| | |
|---|---|
| | Fire Extinguishers |
| NFPA 51B | (2019; TIA 20-1) Standard for Fire Prevention During Welding, Cutting, and Other Hot Work |
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |
| NFPA 70E | (2021) Standard for Electrical Safety in the Workplace |
| NFPA 241 | (2019) Standard for Safeguarding Construction, Alteration, and Demolition Operations |

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 and Health Requirements Manual |

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 1910.1000 | Air Contaminants |
| 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 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 |
| 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 requirements, 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 using the Crane High Hazard working group mishap reporting form (Available at local USACE Safety Office).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation 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

ACCIDENT PREVENTION PLAN (APP); G, RO

SD-06 Test Reports

Monthly Exposure Reports

Notifications and Reports

Accident Reports; G, RO

LHE Inspection Reports

SD-07 Certificates

Crane Operators/Riggers

Standard Lift Plan; G, RO

Critical Lift Plan; G, RO

Activity Hazard Analysis (AHA)

Confined Space Entry Permit

Hot Work Permit

Certificate of Compliance

License Certificates

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 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 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 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.

1.6.1.1.1 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.

1.6.1.2 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.

1.6.1.2.1 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.

1.6.1.2.2 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.

1.6.1.2.3 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.

1.6.1.3 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.

1.6.1.4 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.

1.6.2 Personnel Duties

1.6.2.1 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 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 is 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.

1.6.3 Meetings

1.6.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project must attend the preconstruction conference. 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.

1.6.3.2 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.

1.7 ACCIDENT PREVENTION PLAN (APP)

1.7.1 ACCIDENT PREVENTION PLAN (APP)

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 conference 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.

1.7.2 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.

1.7.3 Plans

Provide plans in the APP in accordance with the requirements outlined in Appendix A of EM 385-1-1, including the following:

1.7.3.1 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.)

1.7.3.2 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.

1.7.3.3 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.

1.7.3.3.1 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.

1.7.3.3.2 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.

1.7.3.4 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.

1.7.3.5 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).

1.7.3.6 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.

1.7.3.7 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.

1.7.3.8 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 00 00 EARTHWORK.

1.7.3.9 Lead, Cadmium, and Chromium Compliance Plan

Identify the safety and health aspects of work involving lead, cadmium and chromium, and prepare in accordance with Section 02 83 00 LEAD REMEDIATION.

1.7.3.10 Asbestos Hazard Abatement Plan

Identify the safety and health aspects of asbestos work, and prepare in accordance with Section 02 82 00 ASBESTOS REMEDIATION.

1.7.3.11 Polychlorinated Biphenyls (PCB) Plan

Identify the safety and health aspects of Polychlorinated Biphenyls work, and prepare in accordance with Sections 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL.

1.7.3.12 Site Demolition Plan

Identify the safety and health aspects, and prepare in accordance with Section 02 41 00 DEMOLITION and referenced sources.

1.8 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.

1.8.1 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.

1.8.2 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.

1.9 DISPLAY OF SAFETY INFORMATION

1.9.1 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.

1.9.2 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.

1.10 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in paragraph REFERENCES. Maintain applicable equipment manufacturer's manuals.

1.11 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.

## 1.12 NOTIFICATIONS and REPORTS

### 1.12.1 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; Contractt 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.

### 1.12.2 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 USACE Accident Report ENG Form 3394, and provide the report to the Contracting Officer within 5 calendar days of the accident. The Contracting Officer will provide copies of any required or special forms.

b. Near Misses: For Army projects, report all "Near Misses" to the GDA, using local mishap reporting procedures, within 24 hrs. The Contracting Officer will provide the Contractor the required forms. 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.

### 1.12.3 LHE Inspection Reports

Submit LHE inspection reports required in accordance with EM 385-1-1 and as specified herein with Daily Reports of Inspections.

1.12.4 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 HOT WORK

1.13.1 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 Contracting Officer's representative. 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 knowledge of emergency response plan and emergency phone numbers/contacts. REPORT ANY FIRE, NO MATTER HOW SMALL, TO THE RESPONSIBLE FIRE DEPARTMENT OR CONTRACTING OFFICER IMMEDIATELY.

1.13.2 Work Around Flammable Materials

Obtain permit approval from a NFPA Certified Marine Chemist, or Certified Industrial Hygienist 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

1.14 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) 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 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.

### 1.15.1 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.

### 1.15.2 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.

### 1.15.3 Sewer Wet Wells

Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

### 1.15.4 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.

## 1.16 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

Not Used

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 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.

3.1.3 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 1910.1000). If material(s) that may be hazardous to human health upon disturbance are encountered during construction operations, stop that portion of work, notify the Contracting Officer immediately and 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 per Section 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS. 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 HECP 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 or Public Utilities 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 HECP. 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.O through 21.O.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. Contractor's operator must remain with the crane during the spot check. Rigging gear must be in accordance with OSHA, ASME B30.9 Standards and federal, state, and local 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. As applicable, 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. As applicable, 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. 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 sitewithout 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.

3.8.2 Utility Location Verification

Physically verify all underground utility locations, including utility depth, by potholing using water, air with non-conductive ends and can include hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within 3 feet of the underground system.

De-energize the circuit for medium voltage cable or direct buried medium voltage cables prior to performing any construction activities within 3 feet of the circuit. If the circuit is reenergized while still exposed, a barrier with danger signs must be provided to limit the approach boundary to 10 feet. De-energize the circuit prior to reentering the 10 feet boundary.

When the excavation will expose and undermine a concrete encased duct bank, submit a concrete encased duct bank electrical support plan for government acceptance prior to undermining the duct bank.

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.

3.10 AIRFIELD SAFETY PRECAUTIONS (DEC 1991)

3.10.1 Definitions

As used in this clause-

a. "Landing areas" means:

(1) The primary surfaces, comprising the surface of the runway, runway shoulders, and lateral safety zones. The length of each primary surface is the same as the runway length. The width of each primary surface is 2,000 feet (1,000 feet on each side of the runway centerline);

(2) The "clear zone" beyond the ends of each runway, i.e., the extension of the primary surface for a distance of 1,000 feet beyond each end of each runway.

(3) All taxiways, plus the lateral clearance zones along each side for the length of the taxiways (the outer edge of each lateral clearance zone is laterally 250 feet from the far or opposite edge of the taxiway, e.g., a 75-foot-wide taxiway would have a combined width of taxiway and lateral clearance zones of 425 feet); and

(4) All aircraft parking aprons, plus the area 125 feet in width extending beyond each edge all around the aprons.

b. "Safety precaution areas" means those portions of approach-departure clearance zones and transitional zones where placement of objects incident to contract performance might result in vertical

projections at or above the approach-departure clearance, or the transitional surface.

(1) The "approach-departure clearance surface" is an extension of the primary surface and the clear zone at each end of each runway, for a distance of 50,000 feet, first along an inclined (glide angle) and then along a horizontal plane, both flaring symmetrically about the runway centerline extended.

(a) The inclined plane (glide angle) begins in the clear zone 200 feet past the end of the runway (and primary surface) at the same elevation as the end of the runway. It continues upward at a slope of 50:1 (1 foot vertically for each 50 feet horizontally) to an elevation of 500 feet above the established airfield elevation. At that point the plane become horizontal, continuing at that same uniform elevation to a point 50,000 feet longitudinally from the beginning of the inclined plane (glide angle) and ending there.

(b) The width of the surface at the beginning of the inclined plane (glide angle) is the same as the width of the clear zone. It then flares uniformly, reaching the maximum width of 16,000 feet at the end.

(2) The "approach-departure clearance zone" is the ground area under the approach-departure clearance surface.

(3) The "transitional surface" is a sideways extension of all primary surfaces, clear zones, and approach-departure clearance surfaces along inclined planes.

(a) The inclined plane in each case begins at the edge of the surface.

(b) The slope of the incline plane is 7:1 (1 foot vertically for each 7 feet horizontally). It continues to the point of intersection with the-

(i) Inner horizontal surface (which is the horizontal plane 500 feet above the established airfield elevation); or

(ii) Outer horizontal surface (which is the horizontal plane 500 feet above the established airfield elevation), whichever is applicable.

(4) The "transitional zone" is the ground area under the transitional surface. (It adjoins the primary surface, clear zone, and approach-departure clearance zone.)

3.10.2 General

a. The Contractor shall comply with the requirements of this clause while-

(1) Operating all ground equipment (mobile or stationary);

(2) Placing all materials; and

(3) Performing all work, upon and around all airfields.

b. The requirements of this clause are in addition to any other safety requirements of this contract.

3.10.3 Contractor Reporting, Notifications, and Operations Requirements

The Contractor shall:

a. Report to the Contracting Officer before initiating any work;

b. Notify the Contracting Officer of proposed changes to locations and operations;

c. Not permit either its equipment or personnel to use any runway for purposes other than aircraft operation without permission of the Contracting Officer, unless the runway is-

(1) Closed by order of the Contracting Officer; and

(2) Marked as provided in paragraph 3.10.4 b. of this clause;

d. Keep all paved surfaces, such as runways, taxiways, and hardstands, clean at all times and, specifically, free from small stones which might damage aircraft propellers or jet aircraft;

e. Operate mobile equipment according to the safety provisions of this clause, while actually performing work on the airfield. At all other times, the Contractor shall remove all mobile equipment to locations-

(1) Approved by the Contracting Officer;

(2) At a distance of at least 750 feet from the runway centerline, plus any additional distance, and

(3) Necessary to ensure compliance with the other provisions of this clause; and

f. Not open a trench unless material is on hand and ready for placing in the trench. As soon as practicable after material has been placed and work approved, the Contractor shall backfill and compact trenches as required by the contract. Meanwhile, all hazardous conditions shall be marked and lighted in accordance with the other provisions of this clause.

3.10.4 Landing Areas

The Contractor shall:

a. Place nothing upon the landing areas without the authorization of the Contracting Officer;

b. Outline those landing areas hazardous to aircraft, using (unless otherwise authorized by the Contracting Officer) red flags by day, and electric, battery-operated low-intensity red flasher lights by night;

c. Obtain, at an airfield where flying is controlled, additional permission from the control tower operator every time before entering any land area, unless the landing area is marked as hazardous in accordance with paragraph 3.10.4 b. of this clause;

d. Identify all vehicles it operates in landing areas by means of a flag on a staff attached to, and flying above, the vehicle. The flag shall be three feet square, and consist of a checkered pattern of international orange and white squares of 1 foot on each side (except that the flag may vary up to ten percent from each of these dimensions);

e. Mark all other equipment and materials in the landing areas, using the same marking devices as in paragraph 3.10.4 b. of this clause; and

f. Perform work so as to leave that portion of the landing area which is available to aircraft free from hazards, holes, piles of material, and projecting shoulders that might damage an airplane tire.

3.10.5 Safety Precaution Areas

The Contractor shall:

a. Place nothing upon the safety precaution areas without authorization of the Contracting Officer.

b. Mark all equipment and materials in safety precaution areas, using (unless otherwise authorized by the Contracting Officer) red flags by day, and electric, battery-operated, low-intensity red flasher lights by night.

c. Provide all objects placed in safety precaution areas with a red light or red lantern at night, if the objects project above the approach-departure clearance surface or above the transitional surface. (DFARS 252.236-7005)

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(SOUTH DAKOTA) NPDES PERMIT REQUIREMENTS FOR STORM WATER DISCHARGES FROM CONSTRUCTION SITES

**05/21**

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(SOUTH DAKOTA) NPDES PERMIT REQUIREMENTS
FOR STORM WATER DISCHARGES
FROM CONSTRUCTION SITES
**05/21**

PART 1 GENERAL

"General Permit For Storm Water Discharges Associated With Construction Activities", Permit No. SDR100000 can be found at the following website: http://denr.sd.gov/des/sw/StormWaterandConstruction.aspx

1.1 REFERENCES (Not Applicable)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having an "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Notice of Intent.

Authorization Letter.

Storm Water Pollution Prevention Plan.

Notice of Termination.

SD-06 Test Reports

Reports.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall be responsible for implementing the terms and requirements of the attached "General Permit For Storm Water Discharges Associated With Construction Activities", Permit No. SDR100000, for storm water discharges from construction sites. The Contractor shall be considered the "permittee". All submissions to the state shall be by certified mail. Copies of the return receipt for each submission shall be included with the submittal to the Contracting Officer's Representative (COR).

## 3.2 IMPLEMENTATION

### 3.2.1 Notice of Intent

The Contractor shall complete and submit a Notice of Intent (NOI) in accordance with Permit No. SDR100000. A copy of the submitted NOI shall be furnished to the COR at least 30 days prior to the commencement of construction activities. The Government shall be considered the "Applicant" and shall sign as such on the form after review by the COR and CEIEC. The Contractor will complete Appendix C in the Permit No.SDR100000. Appendix C is titled Department of Environment and Natural Resources Contractor Certification Form. Which will be submitted with the NOI. The SWPPP must also be completed before the NOI can be submitted for review by the COR and CEIEC. ***NOTE: The Contractor is responsible for any Notice of Violations that occur during the NPDES Permit being in effect. The Contractor will be responsible for paying for any violation fines and/or making any corrections necessary.***

The State Of South Dakota has authorized stormwater permit fees. Effective July 1, 2018 new construction Notice of Intents (NOIs) must include the first year's fee, shall be paid the the Contractor at time of the NOI filing. (If the fee is not paid, the owner of the project will be billed, but the Contractor will be responsible for the fee.) The fee as follows:

- <5 acres = $100
- 5 to <40 acres = $250
- 40 to <80 acres = $500
- 80+ acres = $750

NOTE: These fees are per year and must be paid every year of the project by the Contractor.

### 3.2.2 Authorization Letter

Construction activities regulated under Permit No. SDR100000 shall not begin until an authorization letter from the State granting coverage for the storm water discharges is received by the Contractor. A copy of the authorization letter shall be furnished to the COR at least 2 days prior to the commencement of construction activities.

### 3.2.3 Posting NOI and Authorization Letter

A copy of the NOI and the authorization letter shall be posted by the Contractor at the construction site in a prominent place for public viewing.

### 3.2.4 Storm Water Pollution Prevention Plan

The Contractor shall prepare and implement a Storm Water Pollution Prevention Plan (SWPPP) in accordance with Permit No. SDR100000. Any temporary or permanent erosion and sedimentation control measures shown on the drawings shall be incorporated into the Contractor's SWPPP. . The SWPPP preparer will ensure the plan meets all requirements by performing a checklist inspection of the plan using the "South Dakota NPDES Storm Water Inspection-Construction" checklist. A copy of the SWPPP shall be submitted to the COR and CEIEC on Ellsworth AFB at least 30 days prior to the commencement of construction activities. Copies of all revisions to the SWPPP shall also be submitted to the COR and CEIEC.

3.2.5 Inspections and Reporting

The Contractor shall be responsible for all inspections and reporting required under the NPDES Permit No. SDR100000. Copies of all inspection reports shall be furnished to the COR and CEIEC.

3.2.6 Retention of Records

The Contractor shall retain a copy of the SWPPP, reports, and records of all data used to complete the NOI in accordance with Permit No. SDR100000. A copy of the SWPPP and records that need to retained shall be forwarded to the CEIEC (Kevin Goyer, 28 CE-Water Quality, 605-385-2662) for their recordkeeping. Also add The permit requires that records and reports be kept for at least three years from the date construction permit is terminated.

3.2.7 Notice of Termination

The Contractor shall complete and submit a Notice of Termination (NOT) in accordance with Permit No. SDR100000. The NOT cannot be submitted until the site restoratation meets conditions of Final Stabilization as per the Permit No. SDR100000. A copy of the NOT shall be furnished to the COR for signature prior to submission to the State. The COR as the Applicant must submit the NOT to the State..

3.2.8 Renotification

If the current permit expires prior to completion of construction, the Contractor shall submit a new NOI in accordance with Permit No. SDR100000. A copy of all submissions to the State shall be furnished to the COR.

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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.

AACE INTERNATIONAL (AACE)
1265 Suncrest Towne Centre Drive
Morgantown, WV 26505-1876 USA
Ph: 304-296-8444
Fax: 304-291-5728
Internet: https://web.aacei.org/

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 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@aashto.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 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 FOREST FOUNDATION (AFF)
American Tree Farm System
2000 M Street, NW, Suite 550
Washington, DC 20036
Ph: 202-765-3660
Fax: 202-827-7924
Email: info@forestfoundation.org
Internet: https://www.treefarmsystem.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
Fax: 312-670-5403
Steel Solutions Center: 866-275-2472
E-mail: solutions@aisc.org
Internet: https://www.aisc.org/

AMERICAN IRON AND STEEL INSTITUTE (AISI)
25 Massachusetts Avenue, NW Suite 800
Washington, DC 20001
Ph: 202-452-7100
Internet: https://www.steel.org/

AMERICAN LADDER INSTITUTE (ALI)
330 N. Wabash, Suite 2000
Chicago, IL 60611
Ph: 312-321-6806
Fax: 312-673-6929
E-mail: info@americanladderinstitute.org
Internet: https://www.americanladderinstitute.org

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)
7470 New Technology Way, Suite F
Frederick, MD 21703
Ph: 301-972-1700
Fax: 301-540-8004
E-mail: alsc@alsc.org
Internet: http://www.alsc.org

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
1899 L Street, NW,11th Floor
Washington, DC 20036
Ph: 202-293-8020

Fax: 202-293-9287
E-mail: storemanager@ansi.org
Internet: https://www.ansi.org/

AMERICAN PETROLEUM INSTITUTE (API)
1220 L Street, NW
Washington, DC 20005-4070
Ph: 202-682-8000
Internet: https://www.api.org/

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)
P.O. Box 28518
1711 Arlingate Lane
Columbus, OH 43228-0518
Ph: 800-222-2768 or 614-274-6003
Fax: 614-274-6899
E-mail: tjones@asnt.org
Internet: https://www.asnt.org/

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)
1801 Alexander Bell Drive
Reston, VA 20191
Ph: 800-548-2723; 703-295-6300
Internet: https://www.asce.org/

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)
1791 Tullie Circle, NE
Atlanta, GA 30329
Ph: 404-636-8400 or 800-527-4723
Fax: 404-321-5478
E-mail: ashrae@ashrae.org
Internet: https://www.ashrae.org/

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Two Park Avenue
New York, NY 10016-5990
Ph: 800-843-2763
Fax: 973-882-1717
E-mail: customercare@asme.org
Internet: https://www.asme.org/

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)
520 N. Northwest Highway
Park Ridge, IL 60068
Ph: 847-699-2929
E-mail: customerservice@assp.org
Internet: https://www.assp.org/

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)
18927 Hickory Creek Drive, Suite 220
Mokena, IL 60448
Ph: 708-995-3019
Fax: 708-479-6139
Internet: http://www.asse-plumbing.org

AMERICAN WATER WORKS ASSOCIATION (AWWA)
6666 W. Quincy Avenue
Denver, CO 80235 USA

Ph: 303-794-7711 or 800-926-7337
Fax: 303-347-0804
Internet: https://www.awwa.org/

AMERICAN WELDING SOCIETY (AWS)
8669 NW 36 Street, #130
Miami, FL 33166-6672
Ph: 800-443-9353
Internet: https://www.aws.org/

AMERICAN WOOD COUNCIL (AWC)
222 Catoctin Circle SE, Suite 201
Leesburg, VA 20175
Ph: 800-890-7732
Fax: 412-741-0609
E-mail: publications@awc.org
Internet: https://www.awc.org/

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
P.O. Box 361784
Birmingham, AL 35236-1784
Ph: 205-733-4077
Fax: 205-733-4075
Internet: http://www.awpa.com

APA - THE ENGINEERED WOOD ASSOCIATION (APA)
7011 South 19th St.
Tacoma, WA 98466-5333
Ph: 253-565-6600
Fax: 253-565-7265
Internet: https://www.apawood.org/

ASPHALT INSTITUTE (AI)
2696 Research Park Drive
Lexington, KY 40511-8480
Ph: 859-288-4960
Fax: 859-288-4999
E-mail: info@asphaltinstitute.org
Internet: http://www.asphaltinstitute.org

ASSOCIATED AIR BALANCE COUNCIL (AABC)
1220 19th St NW, Suite 410
Washington, DC 20036
Ph: 202-737-0202
Fax: 202-315-0285
E-mail: info@aabc.com
Internet: https://www.aabc.com/

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)
600 North 18th Street
P.O. Box 2641
Birmingham, AL 35291
Ph: 205-257-3839
Fax: 205-257-2540
Internet: https://aeic.org/

ASTM INTERNATIONAL (ASTM)
100 Barr Harbor Drive, P.O. Box C700
West Conshohocken, PA 19428-2959

Ph: 610-832-9500
Fax: 610-832-9555
E-mail: service@astm.org
Internet: https://www.astm.org/

BACNET INTERNATIONAL (BTL)
BACnet Testing Laboratories
1827 Powers Ferry Road
Building 14, Suite 100
Atlanta, GA 30339
Ph: 770-971-6003
Fax: 678-229-2777
E-mail: info@bacnetinternational.org
Internet: https://www.bacnetlabs.org/

BIFMA INTERNATIONAL (BIFMA)
678 Front Ave. NW, Suite 150
Grand Rapids, MI 49504-5368
Ph: 616-285-3963
E-mail: email@bifma.org
Internet: https://www.bifma.org/

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)
355 Lexington Avenue, 15th Floor
New York, NY 10017
Ph: 212-297-2122
Fax: 212-370-9047
Internet: https://www.buildershardware.com/

CALIFORNIA AIR RESOURCES BOARD (CARB)
1001 I Street
Sacramento, CA 95814
Ph: 800-242-4450
Email: helpline@arb.ca.gov
Internet: https://ww2.arb.ca.gov/

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)
PO Box 997377, MS 0500
Sacramento, CA 95899-7377
Ph: 916-558-1784
Internet: https://www.cdph.ca.gov/

CARPET AND RUG INSTITUTE (CRI)
P.O. Box 2048
Dalton, GA 30722-2048
Ph: 706-278-3176
Fax: 706-278-8835
Internet: https://carpet-rug.org/

CAST IRON SOIL PIPE INSTITUTE (CISPI)
2401 Fieldcrest Drive
Mundelein, IL 60060
Ph: 224-864-2910
Internet: https://www.cispi.org/

CENTERS FOR DISEASE CONTROL AND PREVENTION (CDC)
1600 Clifton Road
Atlanta, GA 30329-4027

Ph: 800-232-4636
TTY: 888-232-6348
Internet: https://www.cdc.gov

COMPOSITE PANEL ASSOCIATION (CPA)
19465 Deerfield Avenue, Suite 306
Leesburg, VA 20176
Ph: 703-724-1128
Fax: 703-724-1588
Internet: https://www.compositepanel.org/

COMPRESSED GAS ASSOCIATION (CGA)
14501 George Carter Way, Suite 103
Chantilly, VA 20151-1788
Ph: 703-788-2700
Fax: 703-961-1831
E-mail: cga@cganet.com
Internet: https://www.cganet.com/

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)
933 North Plum Grove Road
Schaumburg, IL 60173-4758
Ph: 847-517-1200
Fax: 847-517-1206
Internet: http://www.crsi.org/

CONSUMER ELECTRONICS ASSOCIATION (CEA)
1919 South Eads St.
Arlington, VA 22202
Ph: 703-907-7600
E-mail: CTA@CTA.tech
Internet: https://www.cta.tech/

COPPER DEVELOPMENT ASSOCIATION (CDA)
Internet: https://www.copper.org/

COUNCIL ON ENVIRONMENTAL QUALITY (CEQ) (WHITE HOUSE)
722 Jackson Place
Washington DC 20506
Internet: https://www.whitehouse.gov/administration/eop/ceq

CSA GROUP (CSA)
178 Rexdale Blvd.
Toronto, ON, Canada M9W 1R3
Ph: 416-747-4044
Fax: 416-747-2510
E-mail: member@csagroup.org
Internet: https://www.csagroup.org/

DOOR AND ACCESS SYSTEM MANUFACTURERS ASSOCIATION (DASMA)
1300 Sumner Avenue
Cleveland, OH 44115-2851
Ph: 216-241-7333
Fax: 216-241-0105
Internet: https://www.dasma.com/

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)
310 Maxwell Road, Suite 200
Alpharetta, GA 30009

Ph: 678-393-9990
Fax: 678-393-9998
E-mail: emikoski@ecianow.org
Internet: https://www.ecianow.org

ELECTRONIC INDUSTRIES ALLIANCE (EIA)
EIA has become part of the ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

EUROPEAN COMMITTEE FOR STANDARDIZATION (CEN/CENELEC)
CEN-CENELEC Management Centre
Rue de la Science 23
B - 1040 Brussels, Belgium
Ph: 32-2-550-08-11
Fax: 32-2-550-08-19
Internet: https://www.cen.eu/

EUROPEAN UNION (EU)
European Commission
Rue de la Loi 200
1000 Bruxelle
Belgium
Ph: +32 2 299 96 96
Internet: https://ec.europa.eu/info/index_en

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)
25 North Broadway
Tarrytown, NY 10591
Fax: 914-332-1541
E-mail: inquiries@ejma.org
Internet: http://www.ejma.org

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)
615 Chestnut Street
One Independence Mall, Sixth Floor
Philadelphia, PA 19106-4404
Ph: 215-931-5597
E-mail: femar3newsdesk@fema.dhs.gov
Internet: https://www.fema.gov/

FLUID CONTROLS INSTITUTE (FCI)
1300 Sumner Avenue
Cleveland, OH 44115
Ph: 216-241-7333
Fax: 216-241-0105
E-mail: fci@fluidcontrolsinstitute.org
Internet: https://fluidcontrolsinstitute.org/

FLUID SEALING ASSOCIATION (FSA)
994 Old Eagle School Rd. #1019
Wayne, PA 19087-1866
Ph: 610-971-4850
E-mail: info@fluidsealing.com
Internet: www.fluidsealing.com

FM GLOBAL (FM)
270 Central Avenue
Johnston, RI 02919-4949
Ph: 401-275-3000

Fax: 401-275-3029
Internet: https://www.fmglobal.com/

FOREST STEWARDSHIP COUNCIL (FSC)
708 First Street North, Suite 235
Minneapolis, MN 55401
Ph: 612-353-4511
E-mail: info@us.fcs.org
Internet: https://us.fsc.org/

GLASS ASSOCIATION OF NORTH AMERICA (GANA)
National Glass Association
1945 Old Gallows Rd., Suite 750
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Ph: 866-342-5642
Ph: 703-442-4890
Fax: 703-442-0630
Internet: http://www.glasswebsite.com

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Ph: 503-274-0448
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Fax: 973-267-9055
Internet: http://www.pumps.org

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Internet: http://www.ahrinet.org

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Fax: 41-22-919-03-00
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Internet: https://www.iec.ch/

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Internet: http://msshq.org

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Obtain Unified Facilities Criteria (UFC) from:

Whole Building Design Guide (WBDG)
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Fax: 916-372-9950
E-mail: info@woodinst.com
Internet: https://woodworkinstitute.com

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

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QUALITY CONTROL
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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.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D3740 | (2019) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction |
| ASTM E329 | (2021) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection |

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program. Include all associated costs in the applicable Pricing Schedule item.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation 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

Contractor Quality Control (CQC) Plan; G, RO

SD-06 Test Reports

Verification Statement

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Submit Quality Control Personnel experience as submitted per the requirements of Section 00 22 00 EVALUATION CRITERIA. If, because of

reasons beyond the control of the Contractor, the named individuals are not able to fulfill this obligation, present replacement personnel with equal or better skills and experience for acceptance by the Contracting Officer. Obtain the Contracting Officer's wrtitten consent before making any substitution for these designated personnel.

Establish and maintain an effective quality control (QC) system that complies with the Contract Clause titled "Inspection of Construction." QC consist of plans, procedures, and organization necessary to produce an end product which complies with the Contract requirements. The QC system covers all construction operations, both onsite and offsite, and be keyed to the proposed construction sequence. The project superintendent will be held responsible for the quality of work and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the Contract. In this context the highest level manager responsible for the overall construction activities at the site, including quality and production is the project superintendent. The project superintendent maintains a physical presence at the site at all times and is responsible for all construction and related activities at the site, except as otherwise acceptable to the Contracting Officer.

## 3.2 CONTRACTOR QUALITY CONTROL (CQC) PLAN

Submit no later than 10 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The Government will consider an interim plan for the first 30 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional work.

### 3.2.1 Content of the CQC Plan

Include, as a minimum, the following to cover all construction-operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three phase control system for all aspects of the work specified. Include a CQC System Manager that reports to the project manager or another quality management executive in the organization besides the superintendent.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the Contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the CQC System Manager. Furnish copies of these letters to the Contracting Officer.

d. Procedures for scheduling, reviewing, certifying, and managing

submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures must be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test. (Laboratory facilities approved by the Contracting Officer are required to be used.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and is identified by different trades or disciplines, or it is work by the same trade in a different environment. Although each section of the specifications can generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

j. 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. Where the applicable Code issue by the International Code Council (ICC) calls for inspections by the Building Official, the Contractor must include the inspections in the Quality Control Plan and must perform the inspections required by the applicable ICC. The Contractor must perform these inspections using independent qualified inspectors. Include the Special Inspection Plan requirements in the QC Plan.

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in the Contractor Quality Control(CQC) Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, meet with the

Contracting Officer and discuss the Contractor's quality control system. Submit the CQC Plan a minimum of 10 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Government, signed by both the Contractor and the Contracting Officer and will become a part of the contract file. There can be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

## 3.4 QUALITY CONTROL ORGANIZATION

### 3.4.1 Personnel Requirements

The requirements for the CQC organization are a Safety and Health Manager, CQC System Manager, and sufficient number of additional qualified personnel to ensure safety and Contract compliance. The Safety and Health Manager reports directly to a senior project (or corporate) official independent from the CQC System Manager. The Safety and Health Manager will also serve as a member of the CQC Staff Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff maintains a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure Contract compliance. The CQC staff will be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization is responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

### 3.4.2 CQC System Manager

Identify as CQC System Manager an individual within the onsite work organization that is responsible for overall management of CQC and has the authority to act in all CQC matters for the Contractor. The CQC System Manager is required to be a graduate engineer, graduate architect, or a graduate of construction management with a minimum of 2 years construction experience on construction similar to this Contract. Alternatively, the CQC System Manager may be construction person with a minimum of 5 years construction experience on construction similar to this Contract.

This CQC System Manager is on the site at all times during construction and is employed by the prime Contractor. The CQC System Manager is assigned no other duties. Identify in the plan an alternate to serve in the event of the CQC System Manager's absence. The requirements for the alternate are the same as the CQC System Manager.

### 3.4.3 CQC Personnel

Maintain a staff under the direction of the CQC system manager to perform all QC activities. The staff must be of sufficient size to ensure

adequate QC coverage of all work phases, work shifts, and work crews involved in the construction. These personnel may perform other duties, but must be fully qualified by experience and technical training to perform their assigned QC responsibilities and must be allowed sufficient time to carry out these responsibilities. Clearly state the duties and responsibilities of each staff member in the QC Plan. Other technical specifications may specify individuals for maintaining quality control for specific areas of work.

3.4.4 Assignment of CQC System Manager, Project Superintendent, and SSHO Responsibilities

The CQC System Manager, Project Superintendent, and SSHO may not share duties and are required to be separate individuals.

3.4.4.1 Assignment of CQC Personnel During Concrete Paving Operations

The additional CQC person may not serve as the CQC System Manager, Project Superintendent, nor Site Safety and Health Officer.

3.4.5 Construction Quality Management Course

In addition to the above experience and education requirements, the Contractor Quality Control(CQC) System Manager and Alternate CQC System Manager are required to have completed the Construction Quality Management (CQM) for Contractors course.

Contractor personnel who otherwise fulfill all requirements for designation as a CQC Manager, but have not had the opportunity to obtain a CQM certificate due to COVID-19 restrictions, shall be permitted to serve as Quality Control Managers conditioned upon obtaining a CQM-C certificate within 120 days of USACE lifting current in person learning restrictions.

CQC Managers who were in possession of valid CQM certificate (i.e. not delinquent on the 5 year course renewal requirement) as of 01-Mar-2020 will have a grace period for obtaining the CQM renewal training of 6-months from the lifting of COVID-19 restrictions and USACE being able to provide face to face CQM training.

This course is periodically offered at offices indicated at the following web site:

http://www.nwo.usace.army.mil/BusinessWithUs/Contracting/QualityManagement.aspx

The exact date and location for the sessions will be determined approximately 30 calendar days in advance by the trainer (POC). Cost varies by location per student.

The Construction Quality Management Training certificate expires after 5 years. If the CQC System Manager's certificate has expired, retake the course to remain current.

The Government reserves the right to recognize certificates issued as a result of virtual training by a certified instructor as valid.

3.4.6 Organizational Changes

Maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, revise the CQC Plan to reflect the

changes and submit the changes to the Contracting Officer for acceptance.

## 3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, have to comply with the requirements in Section 01 33 00 SUBMITTAL PROCEDURES. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the contract requirements. When Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING are included in the contract, the submittals required by those sections have to be coordinated with Section 01 33 00 SUBMITTAL PROCEDURES to ensure adequate time is allowed for each type of submittal required.

## 3.6 CONTROL

CQC is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control are required to be conducted by the CQC System Manager for each definable feature of the construction work as follows:

### 3.6.1 Preparatory Phase

This phase is performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase includes:

a. A review of each paragraph of applicable specifications, reference codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government personnel until final acceptance of the work.

b. Review of the Contract drawings.

c. Check to assure that all materials and equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Review Special Inspections required by Section 01 45 35 SPECIAL INSPECTIONS, the Statement of Special Inspections and the Schedule of Special Inspections.

f. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the Contract.

g. Examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

h. Review of the appropriate activity hazard analysis to assure safety requirements are met.

i. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

j. Check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.

k. Discussion of the initial control phase.

l. Schedule all preparatory inspections two(2) weeks in advance. Include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the CQC System Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase is accomplished at the beginning of a definable feature of work. Accomplish the following:

a. Check work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing are in compliance with the contract.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government needs to be notified at least 48 hours in advance of beginning the initial phase for definable feature of work. Prepare separate minutes of this phase by the CQC System Manager and attach to the daily CQC report. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with follow-up phases.

g. The initial phase for each definable feature of work is repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

h. 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.

3.6.3 Follow-up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. Record the checks in the CQC documentation. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work which may

be affected by the deficient work. Do not build upon nor conceal non-conforming work. 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.

3.6.4 Additional Preparatory and Initial Phases

Conduct additional preparatory and initial phases on the same definable features of work if: the quality of on-going work is unacceptable; if there are changes in the applicable CQC staff, onsite production supervision or work crew; if work on a definable feature is resumed after a substantial period of inactivity; or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. Procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. Perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Record results of all tests taken, both passing and failing on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test. If approved by the Contracting Officer, actual test reports are submitted later with a reference to the test number and date taken. Provide an information copy of tests performed by an offsite or commercial test facility directly to the Contracting Officer. Failure to submit timely test reports as stated results in nonpayment for related work performed and disapproval of the test facility for this Contract.

3.7.2 Testing Laboratories

All testing laboratories must be validated by the USACE Material Testing Center (MTC) for the tests to be performed. Information on the USACE MTC with web-links to both a list of validated testing laboratories and for the laboratory inspection request for can be found at: https://mtc.erdc.dren.mil/

Click on "Lab Validation"
Search for a Validation

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel is required to meet criteria detailed in ASTM D3740 and ASTM E329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed the actual cost for the recheck to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the Contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Conduct an inspection of the work by the CQC System Manager near the end of the work, or any increment of the work established by a time stated in the FAR Clause, "Commencement, Prosecution, and Completion of Work", or by the specifications. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications, as required by paragraph DOCUMENTATION. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff 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.

3.8.2 Pre-Final Inspection

The Government will perform the pre-final inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. Ensure that all items on this list have been corrected before notifying the Government, so that a Final inspection with the customer can be scheduled. Correct any items noted on the Pre-Final inspection in a timely manner. These inspections and any deficiency corrections required by this paragraph need to be accomplished within the time slated for completion of the entire work or any particular increment of the work if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative is required to be in attendance at the final acceptance inspection. Additional Government personnel including, but not

limited to, those from Base/Post Civil Facility Engineer user groups, and major commands can also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notify the Contracting Officer at least 14 days prior to the final acceptance inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the Contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. 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 titled "Inspection of Construction".

3.9 DOCUMENTATION

Maintain current records providing factual evidence that required quality control activities and/or tests have been performed. Include in these records the work of subcontractors and suppliers on an acceptable form that includes, as a minimum, the following information:

a. The name and area of responsibility of the Contractor/Subcontractor.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Test and/or control activities performed with results and references to specifications/drawings requirements. Identify the control phase (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals and deliverables reviewed, with Contract reference, by whom, and action taken.

g. Offsite surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions. Include information identified by the "Responsible Individual(s)" for Safety as outlined in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS.

i. Instructions given/received and conflicts in plans and/or specifications.

k. Verification Statement.

Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract. Furnish the original and one copy of these records in report form to the Contracting Officer's

Representative on the first day following the date(s) covered by the report, except that reports need not be submitted for days on which no work is performed. The Government may elect to process these records electronically. Coordinate with the Contracting Officer's Representative. As a minimum, prepare and submit one report for every 7 days of no work and on the last day of a no work period. All calendar days need to be accounted for throughout the life of the contract. The first report following a day of no work will be for that day only. Reports need to be signed and dated by the Contractor Quality Control(CQC) System Manager. Include copies of test reports and copies of reports prepared by all subordinate quality control personnel within the CQC System Manager Report.

## 3.10 SAMPLE FORMS

Generate daily quality control reports using the Government-furnished Construction Contractor Module of RMS specified in Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM). A Sample Quality Control Report (QCR) Form is attached at the end of this section.

## 3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer can 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 or for excess costs or damages by the Contractor.

-- End of Section --

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## CONTRACTORS QUALITY CONTROL REPORT (QCR)
## DAILY LOG OF CONSTRUCTION - MILITARY

REPORT NUMBER 218 Page 1 of 1

DATE 09 Dec 2004 - Thursday

PROJECT D/B Main Fire Station

CONTRACT NUMBER W9128F-04-C-0013 NA

CONTRACTOR Bryan Construction

WEATHER Weather Not Entered

SAMPLE

**QC NARRATIVES**

**No QC Narratives were reported today**

**PREP/INITIAL DATES** (Preparatory and initial dates held and advance notice)

**No preparatory or initial inspections were held today**

**ACTIVITY START/FINISH**

**No activities were started or finished today**

**QC REQUIREMENTS**

**No QC requirements were completed today**

**QA/QC PUNCH LIST** (Describe QC Punch List items issued, Report QC and QA Punch List items corrected)

**No QC Punch List items were issued today**

**No Punch List items were corrected today**

**CONTRACTORS ON SITE** (Report first and/or last day contractors were on site)

**No contractors had their first or last day on site today**

**LABOR HOURS**

**No labor hours were Reported today**

Total hours worked to date: 0.0

**EQUIPMENT HOURS**

**No equipment hours were Reported today**

Total operating hours to date: 0.0

**ACCIDENT REPORTING** (Describe accidents)

**No accidents reported today**

CONTRACTOR CERTIFICATION **On behalf of the contractor, I certify that this Report is complete and correct and all equipment and material used and work performed during this Reporting period are in compliance with the contract plans and specifications, to the best of my knowledge, except as noted above.**

| QC REPRESENTATIVE'S SIGNATURE | DATE | SUPERINTENDENT'S INITIALS | DATE |
|---|---|---|---|
| | | | |

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**11/16**

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SECTION 01 45 00.15 10

RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM)
**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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

1.2 MEASUREMENT AND PAYMENT

The work of this section is not measured for payment. The Contractor is responsible for the work of this section, without any direct compensation other than the payment received for contract items.

1.3 CONTRACT ADMINISTRATION

The Government will use the Resident Management System (RMS) to assist in its monitoring and administration of this contract. The Government accesses the system using the Government Mode of RMS (RMS GM) and the Contractor accesses the system using the Contractor Mode (RMS CM). The term RMS will be used in the remainder of this section for both RMS GM and RMS CM. The joint Government-Contractor use of RMS facilitates electronic exchange of information and overall management of the contract. The Contractor accesses RMS to record, maintain, input, track, and electronically share information with the Government throughout the contract period in the following areas:

Administration
Finances
Quality Control
Submittal Monitoring
Scheduling
Closeout
Import/Export of Data

1.3.1 Correspondence and Electronic Communications

For ease and speed of communications, exchange correspondence and other documents in electronic format to the maximum extent feasible. Some correspondence, including pay requests and payrolls, are also to be provided in paper format with original signatures. Paper documents will govern, in the event of discrepancy with the electronic version.

1.3.2 Other Factors

Other portions of this document have a direct relationship to the

reporting accomplished through RMS. Particular attention is directed to FAR 52.236-15 Schedules for Construction Contracts; FAR 52.232-27 Prompt Payment for Construction Contracts; FAR 52.232-5 Payments Under Fixed-Priced Construction Contracts; Section 01 32 01.00 10 PROJECT SCHEDULE; Section 01 33 00 SUBMITTAL PROCEDURES; Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS; and Section 01 45 00.00 10 QUALITY CONTROL.

## 1.4 RMS SOFTWARE

RMS is a web based application. Download, install and be able to utilize the latest version of RMS within 7 calendar days of receipt of the Notice to Proceed. RMS software, user manuals, access and installation instructions, program updates and training information are available from the RMS website (https://rms.usace.army.mil). The Government and the Contractor will have different access authorities to the same contract database through RMS. The common database will be updated automatically each time a user finalizes an entry or change.

## 1.5 CONTRACT DATABASE - GOVERNMENT

The Government will enter the basic contract award data in RMS prior to granting the Contractor access. The Government entries into RMS will generally be related to submittal reviews, correspondence status, and Quality Assurance (QA) comments, as well as other miscellaneous administrative information.

## 1.6 CONTRACT DATABASE - CONTRACTOR

Contractor entries into RMS establish, maintain, and update data throughout the duration of the contract. Contractor entries generally include prime and subcontractor information, daily reports, submittals, RFI's, schedule updates and payment requests. RMS includes the ability to import attachments and export reports in many of the modules, including submittals. The Contractor responsibilities for entries in RMS typically include the following items:

### 1.6.1 Administration

#### 1.6.1.1 Contractor Information

Enter all current Contractor administrative data and information into RMS within 7 calendar days of receiving access to the contract in RMS. This includes, but is not limited to, Contractor's name, address, telephone numbers, management staff, and other required items.

#### 1.6.1.2 Subcontractor Information

Enter all missing subcontractor administrative data and information into RMS CM within 7 calendar days of receiving access to the contract in RMS or within 7 calendar days of the signing of the subcontractor agreement for agreements signed at a later date. This includes name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor is listed separately for each trade to be performed.

#### 1.6.1.3 Correspondence

Identify all Contractor correspondence to the Government with a serial

number. Prefix correspondence initiated by the Contractor's site office with "S". Prefix letters initiated by the Contractor's home (main) office with "H". Letters are numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C" or "RFP".

1.6.1.4 Equipment

Enter and maintain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.6.1.5 Reports

Track the status of the project utilizing the reports available in RMS. The value of these reports is reflective of the quality of the data input. These reports include the Progress Payment Request worksheet, Quality Control (QC) comments, Submittal Register Status, and Three-Phase Control worksheets.

1.6.1.6 Request For Information (RFI)

Create and track all Requests For Information (RFI) in the RMS Administration Module for Government review and response.

1.6.2 Finances

1.6.2.1 Pay Activity Data

Develop and enter a list of pay activities in conjunction with the project schedule. The sum of pay activities equals the total contract amount, including modifications. Each pay activity must be assigned to a Contract Line Item Number (CLIN). The sum of the activities assigned to a CLIN equals the amount of each CLIN.

1.6.2.2 Payment Requests

Prepare all progress payment requests using RMS. Update the work completed under the contract at least monthly, measured as percent or as specific quantities. After the update, generate a payment request and prompt payment certification using RMS. Submit the signed prompt payment certification and payment request as well as supporting data either electronically or by hard copy. Unless waived by the Contracting Officer, a signed paper copy of the approved payment certification and request is also required and will govern in the event of discrepancy with the electronic version.

1.6.3 Quality Control (QC)

Enter and track implementation of the 3-phase QC Control System, QC testing, transferred and installed property and warranties in RMS. Prepare daily reports, identify and track deficiencies, document progress of work, and support other Contractor QC requirements in RMS. Maintain all data on a daily basis. Insure that RMS reflects all quality control methods, tests and actions contained within the Contractor Quality Control (CQC) Plan and Government review comments of same within 7 calendar days of Government acceptance of the CQC Plan.

1.6.3.1 Quality Control (QC) Reports

The Contractor's Quality Control (QC) Daily Report in RMS is the official report. The Contractor can use other supplemental formats to record QC data, but information from any supplemental formats are to be consolidated and entered into the RMS QC Daily Report. Any supplemental information may be entered into RMS as an attachment to the report. QC Daily Reports must be finalized and signed in RMS within 24 hours after the date covered by the report. Provide the Government a printed signed copy of the QC Daily Report, unless waived by the Contracting Officer.

1.6.3.2 Deficiency Tracking.

Use the QC Daily Report Module to enter and track deficiencies. Deficiencies identified and entered into RMS by the Contractor or the Government will be sequentially numbered with a QC or QA prefix for tracking purposes. Enter each deficiency into RMS the same day that the deficiency is identified. Monitor, track and resolve all QC and QA entered deficiencies. A deficiency is not considered to be corrected until the Government indicates concurrence in RMS.

1.6.3.3 Three-Phase Control Meetings

Maintain scheduled and actual dates and times of preparatory and initial control meetings in RMS. Worksheets for the three-phase control meetings are generated within RMS.

1.6.3.4 Labor and Equipment Hours

Enter labor and equipment exposure hours on a daily basis. Roll up the labor and equipment exposure data into a monthly exposure report.

1.6.3.5 Accident/Safety Reporting

Both the Contractor and the Government enter safety related comments in RMS as a deficiency. The Contractor must monitor, track and show resolution for safety issues in the QC Daily Report area of the RMS QC Module. In addition, follow all reporting requirements for accidents and incidents as required in EM 385-1-1, Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and as required by any other applicable Federal, State or local agencies.

1.6.3.6 Definable Features of Work

Enter each feature of work, as defined in the approved CQC Plan, into the RMS QC Module. A feature of work may be associated with a single or multiple pay activities, however a pay activity is only to be linked to a single feature of work.

1.6.3.7 Activity Hazard Analysis

Import activity hazard analysis electronic document files into the RMS QC Module utilizing the document package manager.

1.6.4 Submittal Management

Enter all current submittal register data and information into RMS within 7 calendar days of receiving access to the contract in RMS. The information shown on the submittal register following the specification

Section 01 33 00 SUBMITTAL PROCEDURES will already be entered into the RMS database when access is granted. Group electronic submittal documents into transmittal packages to send to the Government, except very large electronic files, samples, spare parts, mock ups, color boards, or where hard copies are specifically required. Track transmittals and update the submittal register in RMS on a daily basis throughout the duration of the contract. Submit hard copies of all submittals unless waived by the Contracting Officer.

1.6.5 Schedule

Enter and update the contract project schedule in RMS by either manually entering all schedule data or by importing the Standard Data Exchange Format (SDEF) file, based on the requirements in Section 01 32 01.00 10 PROJECT SCHEDULE.

1.6.6 Closeout

Closeout documents, processes and forms are managed and tracked in RMS by both the Contractor and the Government. Ensure that all closeout documents are entered, completed and documented within RMS.

1.7 IMPLEMENTATION

Use of RMS as described in the preceding paragraphs is mandatory. Ensure that sufficient resources are available to maintain contract data within the RMS system. RMS is an integral part of the Contractor's required management of quality control.

1.8 NOTIFICATION OF NONCOMPLIANCE

Take corrective action within 7 calendar days after receipt of notice of RMS non-compliance by the Contracting Officer.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 45 35

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**11/20**

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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 | (2018) International Building Code |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-301-01 | (2019, with Change 1, 2022) Structural Engineering |

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.

Structural observations will be performed separately by the Government. The Contractor must provide notification to the Contracting Officer 14 days prior to the following points of construction to allow for structural observation:

a. Foundation construction

b. Installation of new steel framing

c. New openings at existing walls and mezzanine slab

d. Installation of new fire curtain wall, ceiling, and sprinkler piing

## 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 Special Inspector of Record (SIOR)

A licensed engineer in responsible charge of supervision of all special inspectors for the project and approved by the Contracting Officer. The SIOR must be an independent third party entity hired directly by the Prime Contractor.

### 1.3.8 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).

### 1.3.9 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 having the overall responsibility for the Contractor's QC organization.

### 1.3.10 Structural Engineer of Record (SER)

A registered design professional contracted by the Government as an A/E retained by the Prime Contractor 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.

1.3.11 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.

1.3.12 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.

1.3.13 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, Ip, 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 Ip = 1.5.

1.3.14 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 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

SIOR Letter of Acceptance; G-RO

Special Inspections Project Manual; G-RO

Special Inspections Agency's Written NDT Practices with method and evidence of regular equipment calibration where applicable

SD-06 Test Reports

Special Inspections Daily Reports

Special Inspections Biweekly Reports

SD-07 Certificates

AISC Certified Steel Fabricator

AC472 Accreditation

Steel Joist Institute Membership

Certificate of Compliance

Special Inspector of Record Qualifications; G-RO

Special Inspector Qualifications; G-RO

Qualification Records for NDT technicians

SD-11 Closeout Submittals

Interim Report of Special Inspections for Each DFOW; G-RO

Comprehensive Final Report of Special Inspections; G-RO

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 Masonry Construction

1.5.6.1 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

1.5.6.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.7 Verification of Site Soil Condition, Fill Placement and Load-Bearing Requirements

1.5.7.1 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

1.5.7.2 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

1.5.8 Deep Foundations

1.5.8.1 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

1.5.8.2 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

1.5.9 Sprayed Fire Resistant Material

1.5.9.1 Special Inspector

a. ICC Spray-applied Fireproofing Special Inspector Certificate, or

b. ICC Fire Inspector I Certificate with one year of related experience, or

c. Registered Professional Engineer or Architect with related experience

1.5.9.2 Associate Special Inspector

Engineer-In-Training with one year of related experience

1.5.10 Mastic and Intumescent Fire Resistant Coatings

1.5.10.1 Special Inspector

a. ICC Spray-applied Fireproofing Special Inspector Certificate, or

b. ICC Fire Inspector I Certificate with one year of related experience, or

c. Registered Professional Engineer or Architect with related experience

1.5.10.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.11 Exterior Insulation and Finish System (EIFS)

1.5.11.1 Special Inspector

a. AWCI EIFS Inspector Certificate, or

b. Exterior Design Institute Certificate, or

c. Registered Professional Engineer or Architect with related experience

1.5.11.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.12 Fire-Resistant Penetrations and Joints

1.5.12.1 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

1.5.12.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.13 Smoke Control

1.5.13.1 Special Inspector

a. AABC Technician Certification with one year of related experience, or

b. Registered Professional Engineer with related experience

1.5.13.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.14 Special Inspector of Record (SIOR)

Registered Professional Engineer with five years of 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 followingcertifications 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.

International Accreditation Service, AC472 Accreditation

Steel Joist Institute Membership

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 Special Inspector of Record

a. Supervise all Special Inspectors required by the Contract Documents and the IBC.

b. Submit a SIOR Letter of Acceptance to the Contracting Officer attesting to acceptance of the duties of SIOR, signed and sealed by the SIOR.

c. Verify the qualifications of all of the Special Inspectors.

d. Verify the qualifications of fabricators.

e. 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.

f. Submit qualification records for nondestructive testing (NDT) technicians designated for the project.

g. Submit NDT procedures and equipment calibration records for NDT to be performed and equipment to be used for the project.

h. Prepare a Special Inspections Project Manual, which must cover the following:

(1) Roles and responsibilities of the following individuals during Special Inspections: SIOR, SI, ASI, General Contractor's QC Manager and SER.

(2) Organizational chart or communication plan, indicating lines of communication.

(3) Contractor's internal plan for scheduling inspections. Address items such as timeliness of inspection requests, who to contact for inspection requests, and availability of alternate inspectors.

(4) Indicate the Government reporting requirements.

(5) Propose forms or templates to be used by SI and SIOR to document inspections.

(6) Indicate procedures for tracking nonconforming work and verification that corrective work is complete.

(7) Indicate how the SIOR and SI will participate in weekly QC meetings.

(8) Indicate how Special Inspections of shop fabricated items will be handled when the fabricator's shop is not certified in accordance with paragraph FABRICATOR SPECIAL INSPECTIONS.

(9) Include a section in the manual that covers each specific item requiring Special Inspections that is indicated on the Schedule of Special Inspections. Provide names and qualifications of each special inspector who will be performing the Special Inspections for each specific item. Provide detail on how the Special Inspections are to be carried out for each item so that the expectations are clear for the General Contractor and the Subcontractor performing the work.

Make a copy of the Special Inspections Project Manual available on the job site during construction. Submit a copy of the Special Inspections Project Manual for approval.

i. Attend coordination and mutual understanding meeting where the information in the Special Inspections Project Manual will be reviewed to verify that all parties have a clear understanding of the Special Inspections provisions and the individual duties and responsibilities of each party.

j. Maintain a 3-ring binder for the Special Inspector's daily and biweekly reports and the Special Inspections Project Manual. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the SER.

k. Submit a copy of the Special Inspector's daily reports to the QC Manager.

l. Discrepancies that are observed during Special Inspections must be reported 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.

m. Submit a biweekly Special Inspections report until all work requiring Special Inspections is 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 results including nondestructive testing reports.

n. At the completion of each Definable Feature of Work (DFOW) requiring Special Inspections, submit an interim report that documents the Special Inspections completed for that DFOW including corrections of all discrepancies noted in the daily reports. Interim reports of Special Inspections must be signed and dated by the SIOR.

n. At the completion of the project submit a comprehensive final report of Special Inspections that documents the Special Inspections completed for the project including corrections of all discrepancies noted in the daily reports. The comprehensive final report of Special Inspections must be signed, dated and bear the seal of the SIOR.

3.1.2 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.

3.1.3 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 qualification records for nondestructive testing (NDT) technicians designated for the project.

d. Submit a copy of the daily reports to the QC Manager.

e. 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.

f. 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.

g. 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.

h. Submit daily reports to the SIOR.

3.1.4 Structural Engineer of Record (SER)

a. Develop the Statement of Special Inspections and the Schedule of Special Inspections as defined in Chapter 17 of ICC IBC. Submit the Statement of Special Inspections and the Schedule of Special Inspections for approval by the Contracting Officer.

The Statement of Special Inspection must include the following information:

(1) List of Architectural Designated Seismic Systems.

(2) List of Mechanical Designated Seismic Systems.

(3) List of the Electrical Designated Seismic Systems.

(4) Define the periodic walk-down inspections required by UFC 3-301-01.

(5) List of elements that are part of the progressive collapse resistance system.

Develop Schedule of Special Inspection using the template located on the Whole Building Design Guide website at: www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-01-45-35

b. Prior to the start of structural observations submit a written statement identifying the frequency and delineation wind/seismic force resisting system requiring structural observations.

c. At the conclusion of the structural observations submit a final report of structural observations indicating that the structural observation site visits have been made and identify any reported deficiencies

which, to the best of the structural observer's knowledge, have not been resolved.

d. Perform a final walk-down inspection of the designated seismic systems for mechanical and electrical components to ensure that the non-structural elements satisfy life safety mounting requirements as defined in the Statement of Special Inspections.

e. Submit a report of the final walk-down inspection that includes the following:

(1) Record/observations of final site visit

(2) Documentation that all required inspections were performed in accordance with the Statement of Special Inspections.

(3) Documentation that the Designated Seismic Systems were installed in accordance with the construction documents and the requirements of ICC IBC Chapter 17, as modified by UFC 3-301-01.

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: B-21 Weapons Loader Trainer Facility
Location: Rapids City, SD
Project #: D3558802
Date: 11/14/2022

# STATEMENT OF SPECIAL INSPECTIONS

Project Seismic Design Category: A
Project Risk Category: II
Project Design Wind Speed (mph): 112
Number of Stories: 1
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 responsiblities of the Special Inspector (reference the Schedule of Special Inspections for inspection checklists).

| Vertical LFRS Elements | Notes |
|---|---|
| Braced Frames - Steel Systems not specfically designed for Seismic Reistance | North-South direction |
| Braced Frames - Steel Systems not specfically designed for Seismic Reistance | East-West direction |
| | |
| | |
| | |
| | |
| | |
| | |

| Horizontal LFRS Elements | Notes |
|---|---|
| Cast in Place Concrete Floor and Roof Diaphragms | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

Project: B-21 Weapons Loader Trainer Facility
Location: Rapids City, SD
Project #: D3558802
Date: 11/14/2022

**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)

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.

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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 PRIOR TO WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE<br>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 | ✓ Joint preparation<br>✓ Dimensions (alignment, root opening, root face, bevel)<br>✓ Cleanliness (condition of steel surfaces)<br>✓ Tacking (tack weld quality and location)<br>✓ Backing type and fit (if applicable) |
| 6. Configuration and finish of access holes | OBSERVE | |
| 7. Fit-up of fillet welds | OBSERVE | ✓ Dimensions (alignment, gaps at root)<br>✓ Cleanliness (condition of steel surfaces)<br>✓ Tacking (tack weld quality and location) |
| STEEL INSPECTION DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE<br>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 | ✓ Packaging<br>✓ Electrode atmospheric exposure control |
| 10. No welding over cracked tack welds | OBSERVE | |
| 11. Environmental conditions | OBSERVE | ✓ Wind speed within limits<br>✓ Precipitation and temperature |
| 12. Welding Procedures Specification followed | OBSERVE | ✓ Settings on welding equipment<br>✓ Travel speed<br>✓ Selected welding materials<br>✓ Shielding gas type/flow rate<br>✓ Preheat applied<br>✓ Interpass temperature maintained (min./max.)<br>✓ Proper position (F, V, H, OH)<br>✓ Intermix of filler metals avoided |
| 13. Welding techniques | OBSERVE | ✓ Interpass and final cleaning<br>✓ Each pass within profile limitations<br>✓ 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<br>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** | ✓ Crack prohibition<br>✓ Weld/base-metal fusion<br>✓ Crater cross section<br>✓ Weld profiles<br>✓ Weld size<br>✓ Undercut<br>✓ 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<br>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<br>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<br>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<br>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**

[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<br>2018 IBC 1705.2.1, AISC 341-16: Section J6.2 | | |
|---|---|---|
| TASK | INSPECTION TYPE [1] | DESCRIPTION |
| **[NOTE: DOR may uncheck this section for projects NOT designed in accordance with AISC 341 (Seismic Provisions) or for projects designed according to AISC 341, but using an R value equal to 3]** | | |
| 4. 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). |
| 5. 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. |
| 6. 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. |
| 7. 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<br>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<br>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<br>✓ 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 SECTION**

[1] 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 PRIOR TO DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE<br>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 DURING DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE<br>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 AFTER DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE<br>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 DURING WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE<br>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 AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE<br>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 BEFORE 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 DURING 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 AFTER 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<br>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.<br>**[NOTE: DOR must identify critical wind and/or seismic force resisting welds in the contract drawings so that the special inspector can confirm compliance.]** |
| 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.<br>**[NOTE: DOR must identify critical wind and/or seismic force resisting connection/fastener components in the contract drawings so that the special inspector can confirm compliance.]** |
| 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).<br>**[NOTE: DOR must identify critical progressive collapse resisting connection/fastener components in the contract drawings so that the special inspector can confirm compliance.]** |

**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<br>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<br>✓ 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<br>✓ 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<br>✓ Verify that installer is certified for installation of horizontal and overhead installation applications<br>✓ 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 AT START OF CONSTRUCTION IBC 1705.4 (TMS 602-16 TABLES 3 AND 4) | | |
|---|---|---|
| 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 PRIOR TO GROUTING IBC 1705.4 (TMS 602-16 TABLES 3 AND 4) A | | |
| TASK | INSPECTION TYPE [1] | DESCRIPTION |
| Grout space | OBSERVE | |
| 6. Proportions of site-prepared grout and prestressing grout for bonded tendons | OBSERVE | |
| 7. Proportions of site-mixed grout and prestressing grout for bonded tendons | OBSERVE | |
| 8. Placement of masonry units and mortar joints | OBSERVE | |
| 9. Welding of reinforcement | **CONTINUOUS** | |
| MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE DURING CONSTRUCTION IBC 1705.4 (TMS 602-16 TABLES 3 AND 4) | | |
| TASK | INSPECTION TYPE [1] | DESCRIPTION |
| 10. Size and location of structural elements is in compliance | OBSERVE | |
| 11. 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 | |
| 12. Application and measurement of prestressing force | **CONTINUOUS** | |
| 13. Placement of grout and prestressing grout for bonded tendons | **CONTINUOUS** | |
| 14. Placement of AAC masonry units and construction of thin bed mortar joints | **CONTINUOUS** | Continuous for first 5000 square feet only (465 square meters). |
| 15. Observe preparation of grout specimens, mortar specimens, and/or prisms | OBSERVE | |
| 16. 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<br>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<br>2018 IBC 1705.11 & 1705.12.2 | | |
|---|---|---|
| TASK | INSPECTION TYPE [1] | DESCRIPTION |
| **[NOTE: DOR may uncheck this section where sheathing nailing/fasteners (both shearwall and roof) are consistently greater than 4" on center, or if the design wind speed (ASD) is less than 110 mph (49 meters/sec) AND the seismic design category is A or B]** | | |
| 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<br>2018 IBC TABLE 1705.12.8 | | |
|---|---|---|
| **[NOTE: This section is <u>not</u> applicable to Seismic Design Category A. Uncheck this section if this category applies]** | | |
| 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<br>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<br>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 achiever 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 - MICROPILE FOUNDATIONS SECTION

**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

| MICROPILE 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 | A |
| 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<br>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<br>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.<br>**[NOTE: not applicable to masonry or concrete wall applications. Uncheck this section in those cases]** |

**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<br>2018 IBC 1705.12.5, 1705.12.7 | | |
|---|---|---|
| TASK | INSPECTION TYPE [1] | DESCRIPTION |
| **[NOTE: This section is not applicable to Seismic Design Categories A, B, & C. Uncheck this section if one of those categories applies. Confirm Seismic Design Category with the structural engineer]** | | |
| 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** |
| 5. STC Rated Partitions | PERFORM | Contractor shall provide acoustical testing of secure areas in order to demonstrate conformance with requirements indicated in Documents. Contractor shall hire an independent acoustical testing agency to perform acoustical tests in accordance with ASTM E336-20 Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings. Testing shall be conducted to determine the Apparent Sound Transmission Class (ASTC) and Apparent Transmission Loss (ATL) as indicated in the ASTM standard. A maximum of seven tests shall be conducted and observed by the Contracting Officer and Site Security Officer. The Accrediting Officer shall be notified in advance and have the option to attend |

[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.

| | | |
|---|---|---|
| | | testing if possible. Test locations in the building shall be determined by the Site Security Officer. Contractor is responsible for providing a complete report of each test in accordance with Section 13 of ASTM E336. Contractor shall be responsible for remediating failed tests and shall have failed locations re-tested to demonstrate compliance. |

**END SECTION**

## PLUMBING/MECHANICAL/ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION

**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐**

| PLUMBING, MECHANICAL AND ELECTRICAL<br>IBC 1705.12.6 | | |
|---|---|---|
| TASK | INSPECTION TYPE [1] | DESCRIPTION |
| **[NOTE: This section is not applicable to Seismic Design Categories A or B. Uncheck this section if one of those categories applies. Confirm Seismic Design Category with structural engineer]** | | |
| 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.

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**03/21**

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ENVIRONMENTAL PROTECTION
**03/21**

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. AIR FORCE (USAF)

| | |
|---|---|
| AFI 32-1053 | (2009) Integrated Pest Management Program |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2014) Safety and Health Requirements Manual |
| WETLANDS DELINEATION MANUAL | (1987) Corps of Engineers Wetlands Delineation Manual |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 33 CFR 328 | Definitions of Waters of the United States |
| 40 CFR 150 - 189 | Pesticide Programs |
| 40 CFR 260 | Hazardous Waste Management System: General |
| 40 CFR 261 | Identification and Listing of Hazardous Waste |
| 40 CFR 262 | Standards Applicable to Generators of Hazardous Waste |
| 40 CFR 302 | Designation, Reportable Quantities, and Notification |
| 40 CFR 355 | Emergency Planning and Notification |
| 40 CFR 61 | National Emission Standards for Hazardous Air Pollutants |
| 40 CFR 68 | Chemical Accident Prevention Provisions |
| 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

ELLSWORTH AIR FORCE BASE

| | |
|---|---|
| SPCCP | Spill Prevention and Control Counter-Measurement Plan |

1.2 DEFINITIONS

1.2.1 Environmental Pollution and Damage

Environmental pollution and damage is 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 and/or historically.

1.2.2 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.

1.2.3 Contractor Generated Hazardous Waste

Contractor generated hazardous waste means 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 etc.), waste thinners,excess paints, excess solvents, waste solvents, and excess pesticides, and contaminated pesticide equipment rinse water.

1.2.4 Installation Pest Management Coordinator

Installation Pest Management Coordinator (IPMC) is the individual officially designated by the Installation Commander to oversee the Installation Pest Management Program and the Installation Pest Management Plan.

1.2.5 Land Application for Discharge Water

The term "Land Application" for discharge water implies that the Contractor must discharge water at a rate which 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. Land Application must be in compliance with all applicable Federal, State, and local laws and regulations.

1.2.6 Pesticide

Pesticide is defined as any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, or intended

for use as a plant regulator, defoliant or desiccant.

1.2.7 Pests

The term "pests" means arthropods, birds, rodents, nematodes, fungi, bacteria, viruses, algae, snails, marine borers, snakes, weeds and other organisms (except for human or animal disease-causing organisms) that adversely affect readiness, military operations, or the well-being of personnel and animals; attack or damage real property, supplies, equipment, or vegetation; or are otherwise undesirable.

1.2.8 Surface Discharge

The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers,creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.2.9 Waters of the United States

All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.2.10 Wetlands

Those areas that are inundated or saturated by surface or ground water 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. Wetlands generally include swamps, marshes, and bogs. Official determination of whether or not an area is classified as a wetland must be done in accordance with WETLANDS DELINEATION MANUAL.

1.3 GENERAL REQUIREMENTS

Minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work must be protected during the entire duration of this contract. Comply with all applicable environmental Federal, State, and local laws and regulations. Any delays resulting from failure to comply with environmental laws and regulations will be the Contractor's responsibility.

1.4 SUBCONTRACTORS

Ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. Payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor, and payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations are the Contractor's responsibility. All costs associated with this section must be included in the contract price.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation 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

Environmental Protection Plan; G, RO

1.7 CERTIFICATION REQUIREMENTS

An environmental agency may require design and construction documents to be certified by a Professional Engineer (PE) registered in the State of South Dakota. Comply with the certification requirements of the environmental regulatory agencies.

1.8 ENVIRONMENTAL COORDINATION, PERMITS, NOTICES, REVIEWS AND/OR APPROVALS

Contact the appropriate Federal, State, Regional, and local environmental agencies to identify all required environmental permits (construction and operating), notices, reviews, and approvals required for the project. Once the requirements are identified, coordinate the requirements with Ellsworth's Environmental Flight and the Contracting Officer in regard to implementation for a Federal Facility project. The Contractor shall ensure that all coordination, permits, notices, reviews and/or approvals are completed and submitted with each applicable phase of the design. Prior to construction starting for any phase, the Contractor shall assure that all permits and/or approvals are received and copies are submitted to the Contracting Officer. The Contractor shall be responsible for any contract delays resulting from failure to obtain environmental permits, notices, reviews and/or approvals when required.

1.8.1 Applications, Supporting Documents, and Fees

The Contractor shall obtain and complete all environmental permit applications and notices including any documents required for a modification for an existing permit held by the Facility. The Contractor is responsible for preparing all supporting documents, including but not limited to engineering reports, emission surveys, diagrams, pollutant load calculations, etc. If, in lieu of permits, the governing agency requires review and approval of the design, the Contractor shall submit and obtain approval of the design and associated documents. The Contractor shall be responsible for all fees associated with the permits, applications, reviews, approvals, and notices.

1.8.2 Environmental Permits, Notices, Reviews, and/or Approvals

The following is a listing of permits, notices, reviews, and/or approvals which **may be** required for this project. This listing and requirements are not to be considered all-inclusive by the Contractor, but is provided as information that may be used in successfully accomplishing the environmental compliances. See Internet site https://danr.sd.gov/press/PermittingGuides.aspx for South Dakota's Environmental Permitting and Regulation Guide.

a. If construction activities results in disturbance of 1 acre of

land or more (sites that may be smaller than 1 acre but are part of common plan of development are considered to be over 1 acre), coverage under the State of South Dakota Department of Environment and Natural Resources' (SDENR), "General Permit Authorizing Discharges Associated with Contruction Activities Under the South Dakota Surface Water Discharge System" Permit SDR100000 is required. If the current permit is revised by the State of South Dakota to require coverage for a project disturbing less than 1 acre, the Contractor shall be responsible for the applying for coverage under the permit. The Contractor shall be responsible for implementing the terms and requirements of the permit. The Contractor shall complete and submit a Notice of Intent (NOI) in accordance with Permit No. SDR100000. Furnish a copy of the submitted NOI to the COR at least 30 days prior to the commencement of construction activities. The Government shall be considered the "Applicant" and shall sign as such on the NOI form after review by the COR and CEIEC. The Contractor will complete Appendix C in the Permit No. SDR100000. Appendix C is titled " Department of Environment and Natural Resources Contractor Certification Form" and will be submitted with the NOI. The SWPPP must also be completed before the NOI can be submitted for review by the COR and CEIEC. Pay all fees associated with the NPDES permit. Do not begin construction until receiving an authorization letter from the State of South Dakota granting coverage for the storm water discharges. The Contractor shall be responsible for posting a copy of the NOI and the authorization letter at the construction site in a prominent place for public viewing. The Contractor shall prepare and implement a Storm Water Pollution Prevention Plan, inspections, and reporting in accordance with the SDR100000. Any temporary or permanent erosion and sedimentation control measures shown on the drawings shall be incorporated into the Contractor's Storm Water Pollution Prevention Plan. The Contractor shall retain copies of the storm water pollution prevention plan and all reports in accordance with the permit. All submissions to the State shall be made through the COR and Ellsworth AFB.

b. No soil may be removed off-site without approval from EAFB Environmental Flight and the Contracting Officer.

c. The Federal Aviation Administration requires construction at an airport to be coordinated with FAA prior to commencement using FAA Form 7460-1, (Form and further information can be found at http://www.faa.gov/airports/northwest_mountain/engineering/airspace_analysis/ ) "Notice of Proposed Constriction or Alteration". FAA must determine that the height, layout, and composition of the structure are consistent with the Airport Layout Plan (ALP) and will not obstruct the navigable airspace or adversely affect such FAA facilities as navigational aids or buried cables. A permit must be submitted at least 45 days in advance of the construction start date.

The Form 7460-1 includes instructions and is fairly self-explanatory. However, a point of emphasis regarding geographical coordinates: latitude and longitude of the proposed improvement must be provided in order for FAA to evaluate the proposal. Also, the proponent must indicate whether the coordinates' source was based on the 1927 or the 1983 North American Datum. This information is typically found on a USGS 7

1/2' quad map. The source datum of NAD 27 or NAD 83 may be checked in one of the boxes provided on the Form 7460-1 below the coordinates.

For on-airport construction, all tenant or third-party proposals must be submitted through the airport sponsor to the appropriate Airports District Office. FAA will not process proposals for on-airport construction without evidence of airport sponsor concurrence. Construction cranes and tall structures are of particular concern. A copy of the FFA Form 7460-1 needs to be supplied to the COR prior to submittal to the FAA.

d. Ellsworth Air Force Base has a Synethic Minor Air Permit. Any additions to air emmissions on the base will need to be added to this permit. The new generator and boiler have air emissions and will need to be added to the base's air permit. The base Air Quality Program Manager is Jon Epp at 605-385-2687; email address jon.epp@us.af.mil. Once it is determined what boiler and generator will be used, information must be forwarded to the base (Jon Epp) to start the process of adding to their air permit. The State of South Dakota (DENR) will determine what units need to be added to Ellsworth's permit and if any units are exempt. No construction can begin without a construction air permit from DENR. The permitting porcess can take several months so this needs to be started as soon as possible.

## 1.9 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, submit an Environmental Protection Plan for review and approval by the Contracting Officer with review and approval from 28 CES/CEIE. Forward a copy of the Environmental Protection Plan to 28 CES/CEIE. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern must be defined within the Environmental Protection Plan as outlined in this section. Address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but are considered necessary, must be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan must be current and maintained onsite by the Contractor.

### 1.9.1 Compliance

No requirement in this Section will relieve the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor will be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

### 1.9.2 Contents

Include in the environmental protection plan, but not limit it to, the

following:

a. Name(s) of person(s) within the Contractor's organization who is(are) responsible for ensuring adherence to the Environmental Protection Plan.

b. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.

c. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.

d. Description of the Contractor's environmental protection personnel training program.

e. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan must include monitoring and reporting requirements to assure that the control measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

f. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.

g. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.

h. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.

i. Drawing showing the location of borrow areas.

j. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Prevention Control Plan and Countermeasures Plan (SPCCP) supplements the requirements of EM 385-1-1 and Ellsworth AFB Spill Prevention and Control Counter-Measurement Plan SPCCP. This plan shall include as a minimum:

(1) The name of the individual who will report any spills or hazardous substance releases and who will follow up with complete documentation. This individual shall immediately (within 1 hour of a suspected release--this could also include the inexplicable loss of HAZMAT from a storage vessel or tank.) notify the Contracting Officer, Ellsworth AFB Fire Department, and the 28 CES/CEIEC. The 28 CES/CEIEC prefers to notify the regulatory agencies because the agencies usually direct installation (Ellsworth AFB) personnel to undertake specific actions. 28

CES/CEIEC will be the Subject-Matter Experts interacting with regulatory agencies and providing guidance to the Contractor on the terms of the cleanup until the event can be closed. The Contractor will be responsible to cleanup spill sites as required by Ellsworth AFB and the regulatory agency. The Contractor will perform all sampling as required by the regulatory agency to determine the nature and extent of contamination, ensure spill site restoration and facilitate proper disposal of the contaminated material. If the spill cannot be easily closed, a long-term cleanup plan may be required. The plan shall contain a list of the required reporting channels and telephone numbers.

(2) The name and qualifications of the individual who will be responsible for implementing and supervising the containment and clean up.

(3) Training requirements for Contractor's personnel and methods of accomplishing the training.

(4) A list of materials and equipment to be immediately available at the job site, tailored to cleanup work of the potential hazard(s) identified.

(5) The names and locations of suppliers of containment materials and locations of additional fuel oil recovery, cleanup, restoration, and material-placement equipment available in case of an unforeseen spill emergency.

(6) The methods and procedures to be used for expeditious contaminant cleanup. The SPCCP needs to establish reasonable precautions to prevent, detect, respond to, and clean up spills of oil or other hazardous substances used on site. Plan implementation requires having on-site containment and clean-up resources and periodic compliance inspections.

(7) Small spills may be cleaned up without emergency response; however, if the Contractor experiences a spill that exceeds Class II as defined on the Gold Plan 1 (GP-1) form, or the spill gets into a storm drain, the Contractor must call the Ellsworth AFB Emergency Response (Fire Department) to help ensure the release is controlled, to the most extent possible.

(8) The Contractor shall document any spill of oil or hazardous material as described on the GP-1 spill notification form.

k. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris and schedules for disposal.

(1) Identify any subcontractors responsible for the transportation and disposal of solid waste. Submit licenses or permits for solid waste disposal sites that are not a commercial operating facility.

(2) Evidence of the disposal facility's acceptance of the solid waste must be attached to this plan during the construction. Attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. Submit the report for the previous quarter on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted (e.g. the first

working day of January, April, July, and October).

(3) Indicate in the report the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted and cost of diversion (cost may be estimated).

(4) A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. Detail in the plan the Contractor's actions to comply with and to participate in Federal, State, Regional, and local government sponsored recycling programs to reduce the volume of solid waste at the source.

l. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become air borne and travel off the project site.

m. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be onsite at any given time must be included in the contaminant prevention plan. Update the plan as new hazardous materials are brought onsite or removed from the site. The Contractor shall furnish a copy of the initial and all updated contaminant prevention plans including each MSDS and quantities to Ellsworth AFB's Environmental Flight.

n. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan must include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan must include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, include a copy of the permit and associated documents as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan must include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

o. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. Include in the plan methods to assure the protection of known or discovered resources, identifying lines of communication between Contractor personnel and the Contracting Officer.

p. If applicable, a pesticide treatment plan shall be included and updated, as information becomes available. The plan shall include: sequence of treatment, dates, times, locations, pesticide trade name, EPA registration numbers, authorized uses, chemical composition, formulation, original and applied concentration, application rates of active ingredient (i.e. pounds of active ingredient applied), equipment used for application and calibration of equipment. The Contractor is responsible for Federal, State, Regional and Local pest management record keeping and reporting requirements as well as any additional Installation specific requirements. The Contractor shall follow AFI 32-1053 Sections 3.4.13 and 3.4.14 for data required to be reported to the Installation.

1.9.3 Appendix

Attach to the Environmental Protection Plan, as an appendix, copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents.

1.10 PROTECTION FEATURES

This paragraph supplements the Contract Clause PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer will make a joint condition survey. Immediately following the survey, the Contractor will prepare a brief report including 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), as applicable. This survey report will be signed by both the the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor must protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the work under the contract.

1.11 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations from the drawings, plans and specifications, requested by the Contractor and which may have an environmental impact, will be subject to approval by the Contracting Officer with coordination of 28 CES/CEIE and may require an extended review, processing, and approval time. The Contracting Officer with coordination of 28 CES/CEIE reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.12 NOTIFICATION

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 Environmental Protection plan. After receipt of such notice, the Contractor will 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. No time extensions will be granted or equitable adjustments allowed for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

## PART 2 PRODUCTS

NOT USED

## PART 3 EXECUTION

### 3.1 LAND RESOURCES

Confine all activities to areas defined by the drawings and specifications. Identify any land resources to be preserved within the work area prior to the beginning of any construction. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval, except in areas indicated on the drawings or specified to be cleared. Ropes, cables, or guys will not be fastened to or attached to any trees for anchorage unless specifically authorized. Provide effective protection for land and vegetation resources at all times, as defined in the following subparagraphs. Remove stone, soil, or other materials displaced into uncleared areas.

#### 3.1.1 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 which 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. The Contractor's personnel must be knowledgeable of the purpose for marking and/or protecting particular objects.

#### 3.1.2 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved must be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. Restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

#### 3.1.3 Erosion and Sediment Controls

The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. The Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs). BMPs may include, but not be limited to, vegetation cover, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection,

diversion channels, and sedimentation basins. Any temporary measures shall be removed after the area has been stabilized.

3.1.4 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. Temporary movement or relocation of Contractor facilities will be made only when approved. Erosion and sediment controls must be provided for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas must be controlled to protect adjacent areas.

3.2 WATER RESOURCES

Monitor all water areas affected by construction activities to prevent pollution of surface and ground waters. Do not apply toxic or hazardous chemicals to soil or vegetation unless otherwise indicated. For construction activities immediately adjacent to impaired surface waters, the Contractor must be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.2.1 Wetlands

D0 not enter, disturb, destroy, or allow discharge of contaminants into any wetlands.

3.3 AIR RESOURCES

Equipment operation, activities, or processes will be in accordance with all Federal and State air emission and performance laws and standards.

3.3.1 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 which would cause the Federal, State, and local air pollution standards to be exceeded or which 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 at all times. 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 all State and local visibility regulations.

3.3.2 Odors

Odors from construction activities must be controlled at all times. The odors must be in compliance with State regulations and/or local ordinances and may not constitute a health hazard.

3.3.3 Sound Intrusions

Keep construction activities under surveillance and control to minimize environment damage by noise. Comply with the provisions of the State of South Dakota rules.

3.3.4 Burning

Burning is prohibited on the Government premises.

3.4 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes will be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.4.1 Solid Wastes

Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste disposal. A Subtitle D RCRA permitted landfill shall be the minimum acceptable off-site solid waste disposal option. The Contractor shall verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate.

3.4.2 Chemicals and Chemical Wastes

Ellsworth's SWPPP requires that all HAZMATs be stored under cover to prevent contact with storm water (rain and snow) and for all chemical containers 55-gallons or more to be stored on containment decks designed to hold 110% of the contents of the largest container. Oily recyclables should be stored in covered bins. Chemicals shall be dispensed ensuring no spillage to the ground or water. The Contractor must implement these requirements as described in Ellsworth's SWPPP and my reference Ellsworth's SWPPP or SPCC in the Contractor's construction SWPPP.

Chemical waste shall be collected in corrosion resistant, compatible containers suitable to meet Department of Transportation (DOT) shipping requirements for the waste. Collection containers must be approved by the installation Hazardous Waste Program Manager prior to use. Collection drums shall be monitored and removed to a staging or storage area when contents are within 6 inches of the top. Wastes shall be characterized, managed, stored, and disposed of in accordance with Sections 01 74 19, and 02 81 00, waste management procedures as described in the waste management plans, and all federal, state, and local hauling and disposal regulations. All hazardous materials brought on the facility shall be bar coded and tracked by the Ellsworth AFB's HAZMART. The Contractor shall contact the HAZMART office prior to hazardous materials being brought on the facility to arrange for on-site bar coding and tracking by the HAZMART office.

Periodic inspections of dispensing and staging areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government.

3.4.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials

Hazardous wastes are defined in 40 CFR 261, or are as defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 - 178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262 and shall manage and store hazardous waste in accordance with the Installation hazardous waste management plan. The Contractor shall take sufficient measures to prevent spillage of hazardous and toxic materials during dispensing. The Contractor shall properly collect, containerize, and label any hazardous waste generated from the project. Segregate hazardous waste from other materials and wastes, protect it from the weather by placing it in a safe covered location, and take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for proper characterization, collection, storage, packaging (containerizing), labeling, marking, and placarding of hazardous waste and hazardous material. In the event that hazardous waste disposal is required for the project, the contractor is responsible to manifest and dispose of all hazardous waste, generated during the project, at a proper EPA permitted Treatment, Storage, and Disposal Facility (TSDF). No shipments of hazardous waste from Ellsworth AFB can occur until the HWPM (Hazardous Waste Program Manager) (Douglas Baldwin, Hazardous Waste, Solid Waste, and Qualified Recycling Program Manager at 605-385-2684) has reviewed the shipment and has signed the Uniform Hazardous Waste Manifest. The contractor will properly containerize and label all hazardous waste generated during the project in containers suitable to meet Department of Transportation (DOT) shipping requirements for the waste. Prior to use, the Ellsworth AFB HWPM must approve all containers the contractor (coordinate with COR to contact the Ellsworth AFB HWPM for approval) will use for the collection of hazardous waste disposal. Small amounts of hazardous waste may be allowed to be disposed of through the HAZMART on a case by case basis. The contractor must deliver the waste allowed to be disposed of through HAZMART to the HAZMART facility in the DOT approved containers.
The contractor will provide the HAZMART contractor with copies of all waste analysis reports, Safety Data Sheets (SDSs), and any other documentation used to characterize the waste. Unused or partially used containers of hazardous materials (i.e., paint, adhesives) are not hazardous waste and will be taken off the facility for reuse by the Contractor. Spills of hazardous or toxic materials shall be immediately reported to the Contracting Officer. Cleanup and cleanup costs due to spills shall be the Contractor's responsibility. The disposition of Contractor generated hazardous waste and excess hazardous materials are the Contractor's responsibility.

3.4.4 Control and Management of Asbestos-Containing Material(ACM)

Manage and dispose of asbestos- containing waste in accordance with 40 CFR 61. Refer to Section 02 82 00 ASBESTOS REMEDIATION. Manifest asbestos-containing waste and provide the manifest to the Contracting Officer. Notifications to the state and Ellsworth AFB Air Program Manager are required before starting any asbestos work.

3.4.5 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.

3.4.6 Control and Management of Polychlorinated Biphenyls(PCBS)

Materials contaminated with PCBs shall be collected and containerized in containers suitable to meet Department of Transportation (DOT) shipping requirements for the waste. Prior to use, the Ellsworth AFB HWPM must approve all containers (coordinate with COR to contact the Ellsworth AFB HWPM for approval) the contractor will use for the collection of PCB waste disposal. The containerized PCB waste will be turned in to the HAZMART for proper handling and disposal, telephone 605-385-6616. Manage and dispose of PCB-contaminated waste in accordance with 40 CFR 761 and Section 02 61 13 EXCAVATION AND HANDLING OF CONTAMINATED MATERIALS.

3.4.7 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles must be conducted in a manner that affords the maximum protection against spill and evaporation. Manage and store fuel, lubricants and oil in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded must be taken to the HAZMART for disposal. Used oil must be stored in corrosion-resistant containers marked with the words “Used Oil” in a minimum of 1” high letters. Storage of fuel on the project site is not allowed. Fuel must be brought to the project site each day that work is performed.

3.4.8 Waste Water

Disposal of waste water will be as specified below.

a. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.

b. Ground water shall not be pumped or discharged without prior approval from the State of South Dakota. The Contractor must obtain dewatering permits from the State of South Dakota and implement all permit conditions.

c. Water generated from the flushing of lines after disinfection or disinfection in conjunction with hydrostatic testing shall be land applied in accordance with all Federal, State, and local laws and regulations for land application or discharged into the sanitary sewer with prior approval and/or notification to the Waste Water Treatment Plant's Operator. Ellsworth AFB has a land application plan which may be used to guide land application of waters used for hydrostatic testing and sanitation lines and vessels.

3.5 RECYCLING AND WASTE MINIMIZATION

Participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project.

## 3.6 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

Maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. Submit a report to Ellsworth AFB's Environmental Flight through the Contracting Officer on the first working day after each fiscal year quarter, starting the first quarter that non-hazardous solid waste has been generated. **The diversion report should also provide a cost of disposal, recycling or diversion. Cost can be estimated.** Include the following in the report:

| | |
|---|---|
| Construction and Demolition (C&D) Debris Disposed | _____ cubic yards or tons, as appropriate |
| Construction and Demolition (C&D) Debris Recycled | _____ cubic yards or tons, as appropriate |
| Total C&D Debris Generated | _____ cubic yards or tons, as appropriate |
| Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) | _____ cubic yards or tons, as appropriate |

## 3.7 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources will be temporarily 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.

## 3.8 BIOLOGICAL RESOURCES

Minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The protection of threatened and endangered animal and plant species, including their habitat, is the Contractor's responsibility in accordance with Federal, State, Regional, and local laws and regulations.

## 3.9 INTEGRATED PEST MANAGEMENT

In order to minimize impacts to existing fauna and flora, the Contractor through the Contracting Officer, must coordinate with the Installation Pest Management Coordinator (IPMC) at the earliest possible time prior to pesticide application. Discuss integrated pest management strategies with the IPMC and receive concurrence from the IPMC through the COR prior to the application of any pesticide associated with these specifications. Installation Project Office Pest Management personnel will be given the opportunity to be present at all meetings concerning treatment measures

for pest or disease control and during application of the pesticide. The use and management of pesticides are regulated under 40 CFR 150 - 189.

3.9.1 Pesticide Delivery and Storage

Deliver pesticides to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses. Store pesticides according to manufacturer's instructions and under lock and key when unattended.

3.9.2 Qualifications

For the application of pesticides, use the services of a subcontractor whose principal business is pest control. The subcontractor must be licensed and certified in the state where the work is to be performed.

3.9.3 Pesticide Handling Requirements

Formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and use the clothing and personal protective equipment specified on the labeling for use during all phases of the application. Furnish Material Safety Data Sheets (MSDS) for all pesticide products.

3.9.4 Application

Apply pesticides using a State Certified Pesticide Applicator in accordance with EPA label restrictions and recommendation. The Certified Applicator must wear clothing and personal protective equipment as specified on the pesticide label. The Contracting Officer will designate locations for water used in formulating. Do not allow the equipment to overflow. All equipment must be inspected for leaks, clogging, wear, or damage and repaired prior to application of pesticide.

3.10 PREVIOUSLY USED EQUIPMENT

Clean all previously used construction equipment prior to bringing it onto the project site. Ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. Consult with the USDA jurisdictional office for additional cleaning requirements.

3.11 MAINTENANCE OF POLLUTION FACILITIES

Maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.12 MILITARY MUNITIONS

In the event military munitions, as defined in 40 CFR 260, are discovered or uncovered, the Contractor will immediately stop work in that area and immediately inform the Contracting Officer.

3.13 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel must be trained in all phases of environmental protection and pollution control. If hazardous waste will be generated during the project, the Contractor is required to provide proper hazardous waste training to all personnel who handle hazardous waste and their

supervisors in accordance with EPA federal regulation 40 CFR 267.17(a)(7). Conduct environmental protection/pollution control meetings for all personnel prior to commencing construction activities. Additional meetings must be conducted for new personnel and when site conditions change. Include in the training and meeting agenda: 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, wetlands, and endangered species and their habitat that are known to be in the area.

## 3.14 POST CONSTRUCTION CLEANUP

The Contractor will clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". Unless otherwise instructed in writing by the Contracting Officer, obliterate all signs 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. The disturbed area must be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

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SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

**07/06**

PART 1 GENERAL

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PART 2 PRODUCTS

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-- End of Section Table of Contents --

SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

**07/06**

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.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 40 CFR 247 | Comprehensive Procurement Guideline for Products Containing Recovered Materials |

1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. Make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

**02/19, CHG 1: 08/20**

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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. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EP 415-1-266 | (2000) Construction -- Resident Engineer Management Guide (REMG) for Hazardous, Toxic, and Radioactive Waste (HTRW) Projects |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 40 CFR 262 | Standards Applicable to Generators of Hazardous Waste |

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 60 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 and 28 CES/CEIE for review and 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 Quality Control Manager, as specified in Section 01 45 00.00 10 QUALITY CONTROL, 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. The Ellsworth AFB HWPM must approve all facilities used for recycling, reuse, and disposal.

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 steams 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" classification. Submittals not having a "G" classification are 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

Construction Waste Management Plan; G, RO

SD-06 Test Reports

Quarterly Reports

Annual Report

SD-11 Closeout Submittals

Final Construction Waste Diversion Report

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 10 QUALITY CONTROL. At a minimum, discuss and document waste management goals at following meetings:

a. Preconstruction meeting.

b. Regular site meetings.

c. Work safety meeting (if applicable).

1.7 CONSTRUCTION WASTE MANAGEMENT PLAN

Submit Construction Waste Management Plan within 30 days after notice to proceed. Revise and resubmit Construction Waste Management Plan until it receives final approval from 28 CES/CEIE and 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.

Distribute copies of the waste management plan to each subcontractor, Quality Control 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 though 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. The contractor will provide a copy of all manifests, weight tickets, sales receipts, and invoices for diversion and disposal to 28 CES/CEIE.

### 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 and 28 CES/CEIE during construction or incidental demolition activities. Provide a copy of the diversion records to 28 CES/CEIE and the Contracting Officer upon completion of the construction, incidental demolitions or minor deconstruction activities.

## 1.9 REPORTS

### 1.9.1 General

Maintain current construction waste diversion information on site for periodic inspection by the Contracting Officer. Include in the quarterly reports, annual reports and final reports: the project name, contract information, information for waste generated, diverted and disposed of for the current reporting period and show cumulative totals for the project. Reports must identify quantifies of waste by type and disposal method. Also include in each report, supporting documentation to include manifests, weigh tickets, receipts, and invoices specifically identifying the project and waste material type and weighted sum.

### 1.9.2 Quarterly Reporting

Provide cumulative reports at the end of each quarter (December, March, June, and September, corresponding with the federal fiscal year for reporting purposes). Submit quarterly reports not later than 15 calendar days after the preceding quarter has ended. Submit Quarterly Reports to 28 CES/CEIE and the Contracting Officer.

### 1.9.3 Annual Reporting

Provide a cumulative construction waste diversion report annually. Submit annual report not later than 30 calendar days after the preceding fourth quarter has ended. Provide copy of annual construction waste diversion report to 28 CES/CEIE and the Contracting Officer.

## 1.10 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.

1.11 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 ENVIROMENTAL PROTECTION and Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS. Separate materials by one of the following methods described herein:

1.11.1 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.

1.11.2 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.

1.11.3 Other Methods

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.12 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:

1.12.1 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.

1.12.2 Recycle

Recycle non-hazardous construction and demolition/debris materials that are not suitable for reuse. Track rejection of contaminated recyclable materials by the recycling facility. Rejected recyclables materials will not be counted as a percentage of diversion calculation. All fluorescent lamps, HID lamps, mercury (Hg) -containing thermostats, ampoules, mercury containing equipment, and PCBs-containing ballasts and electrical components must be disposed of through the HAZMART. The contractor will properly containerize and label all Universal Waste and PCB Waste generated during the project in containers suitable to meet Department of Transportation (DOT) shipping requirements for the waste. Prior to use, the Ellsworth AFB HWPM must approve all containers the contractor will use for the collection of these wastes for disposal. The contractor must deliver the Universal Waste and PCB Waste to the HAZMART facility in the DOT approved containers. The contractor will provide the HAZMART contractor with copies of all waste analysis reports, Safety Data Sheets (SDSs), and any other documentation used to characterize the waste. Do not crush lamps on site as this creates a hazardous waste stream with additional handling requirements.

1.12.3 HAZMAT Disposal

Provide all the materials required for containerizing and labeling containers at Hazardous Waste Satellite Accumulation Points in accordance with 40 CFR 262. Provide all the materials for labeling, marking, placarding and transportation of hazardous waste and hazardous materials in conformance with DOT and EP 415-1-266. Details in this specification must not be construed as establishing the limits of the Contractor's responsibility.

1.12.4 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.

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

**08/15**

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
**08/15**

PART 1 GENERAL

1.1 SUSTAINABILITY REQUIREMENTS

Materials in this technical specification may contribute towards contract compliance with sustainability requirements. See Section 01 33 29 SUSTAINABILITY REPORTING for project requirements.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation ubmittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-10 Operation and Maintenance Data

Training Plan; G, RO

Training Outline; G, RO

Training Content; G, RO

SD-11 Closeout Submittals

Training Video Recording; G, RO

Validation of Training Completion; G, RO

1.3 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.

1.3.1 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.

1.3.2 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 3 for commissioned items without a specified data package requirement in the individual technical sections. Provide a Data Package 3 instead of Data Package 1 or 2, as specified in the individual technical section, for items that are commissioned.

1.3.3 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.

1.3.4 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.

1.4 O&M DATABASE

Provide electronic Facility Data deliverables in compliance with 01 78 24.00 10 FACILITY DATA REQUIREMENTS.

1.5 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.

See 01 78 24.00 10 FACILITY DATA REQUIREMENTS for additional requirements.

1.5.1 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.

See 01 78 24.00 10 FACILITY DATA REQUIREMENTS for additional requirements.

1.5.2 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

1.6 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.

1.6.1 Operating Instructions

Provide specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.6.1.1 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.

1.6.1.2 Operator Prestart

Provide procedures required to install, set up, and prepare each system for use.

1.6.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.6.1.4 Normal Operations

Provide Control Diagrams with data to explain operation and control of systems and specific equipment. Provide narrative description of Normal Operating Procedures.

1.6.1.5 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.

1.6.1.6 Operator Service Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

1.6.1.7 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.

1.6.1.8 Operating Log

Provide forms, sample logs, and instructions for maintaining necessary operating records.

1.6.1.9 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.

1.6.2 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.

1.6.2.1 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.

1.6.2.2 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.

1.6.3 Repair

Provide manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.6.3.1 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.

1.6.3.2 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.

1.6.3.3 Repair Procedures

Provide instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.6.3.4 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.

1.6.3.5 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.

1.6.3.6 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.

1.6.4 Real Property Equipment

Report all real property installed equipment in the project Facility Data Workbook. See 01 78 24.00 10 FACILITY DATA REQUIREMENTS for additional requirements.

1.6.5 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:

1.6.5.1 Product Submittal Data

Provide a copy of SD-03 Product Data submittals documented with the required approval.

1.6.5.2 Manufacturer's Instructions

Provide a copy of SD-08 Manufacturer's Instructions submittals documented with the required approval.

1.6.5.3 O&M Submittal Data

Provide a copy of SD-10 Operation and Maintenance Data submittals documented with the required approval.

1.6.5.4 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.

1.6.5.5 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 01 78 36.00 24 WARRANTY OF CONSTRUCTION.

1.6.5.6 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 01 78 36.00 24 WARRANTY OF CONSTRUCTION.

1.6.5.7 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.

1.6.5.8 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.

1.6.5.9 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.

1.6.5.10 Field Test Reports

Provide a copy of Field Test Reports (SD-06) submittals documented with the required approval.

1.6.5.11 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.

1.7 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:

1.7.1 Data Package 1

a. Safety precautions and hazards

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Warranty information

e. Extended warranty information

f. Contractor information

g. Spare parts and supply list

1.7.2 Data Package 2

a. Safety precautions and hazards

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan, schedule, and procedures

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Extended warranty information

m. Contractor information

1.7.3 Data Package 3

a. Safety precautions and hazards

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Operating log

h. Lubrication data

i. Preventive maintenance plan, schedule, and procedures

j. Cleaning recommendations

k. Troubleshooting guides and diagnostic techniques

l. Wiring diagrams and control diagrams

m. Maintenance and repair procedures

n. Removal and replacement instructions

o. Spare parts and supply list

p. Product submittal data

q. O&M submittal data

r. Parts identification

s. Warranty information

t. Extended warranty information

u. Testing equipment and special tool information

v. Testing and performance data

w. Contractor information

x. Field test reports

1.7.4 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

1.7.5 Data Package 5

a. Safety precautions and hazards

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan, schedule, and procedures

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. Manufacturer's instructions

n. O&M submittal data

o. Parts identification

p. Testing equipment and special tool information

q. Warranty information

r. Extended warranty information

s. Testing and performance data

t. Contractor information

u. 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 Facility Data Workbook and Facility Document Set as defined in 01 78 24.00 10 FACILITY DATA REQUIREMENTS. 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. 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 Facility Data Workbook and Facility Document Set as defined in 01 78 24.00 10 FACILITY DATA REQUIREMENTS 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 QC and CxA in accordance with Section 01 45 00.00 10 QUALITY CONTROL.

-- End of Section --

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**05/18**

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SECTION 01 78 24.00 10

FACILITY DATA REQUIREMENTS
**05/18**

PART 1 GENERAL

This specification requires the collection, organization, and turnover of electronic Facility Data for specific assets designed and constructed as part of this contract. Provide a Facility Document Set (FDS) and Facility Data Workbook (FDW) as defined in this specification. See Sections 01 33 00 SUBMITTAL PROCEDURES, 01 78 39.00 24 AS-BUILT DRAWINGS, and 01 78 23 OPERATION AND MAINTENANCE DATA, for additional Facility Data delivery requirements.

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 ORGANIZATION FOR STANDARDIZATION (ISO)

| | |
|---|---|
| ISO 19005-3 | (2012) Document Management -- Electronic Document File Format for Long-Term Preservation -- Part 3: Use of ISO 32000-1 with Support for Embedded Files (PDF/A-3) |
| ISO 32000-1 | (2008) Document Management -- Portable Document Format -- Part 1: PDF 1.7 |

1.2 DEFINITIONS AND ABBREVIATIONS

1.2.1 Assets

Assets are specific items of property or equipment.

1.2.2 Attributes

Attributes are individual pieces of Facility Data that describe facilities and their associated assets.

1.2.3 Facility Data

Information defined and collected in the Facility Data Workbook (FDW) and Facility Document Set (FDS).

1.2.4 Facility Document Set (FDS)

An electronically compiled and organized document containing the supporting documents and data used to populate the Facility Data Workbook during its respective phase of development.

a. For construction-based deliverables, the FDS is comprised of the project Operation and Maintenance Data Packages and Government-Approved Record drawings.

1.2.5 Facility Data Workbook (FDW)

A pre-formatted spreadsheet template used to compile Asset, Attribute, Facility, and Space Data that the Government wishes to manage via electronic means. The FDW also contains all requirements associated with proper collection, organization, and turnover of the Facility Data.

1.2.6 Facility Data Project Execution Plan (FDPxP)

A document that describes the clear and organized plan for the collection, organization, and turnover of the Facility Data deliverables required by this specification. The Contractor may consolidate BIM PxP requirements defined in 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS and FDPxP requirements defined herein and integrate them into a single, consolidated BIM/Facility Data PxP for Government approval.

1.3 UNITS OF MEASURE

Provide Facility Data deliverables utilizing the units of measure identified in the contract documents.

1.4 SUSTAINABILITY REQUIREMENTS

Materials in this technical specification may contribute towards contract compliance with sustainability requirements. See Section 01 33 29 SUSTAINABILITY REPORTING for project requirements.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation. Submittals not having a "G" designation are for information only. When used, a designation following the "G" designation 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

Facility Data Project Execution Plan(FDPxP); G, DO

SD-10 Operation and Maintenance Data

Facility Data Workbook, Construction Progress; G, RO

Facility Document Set, Construction Progress; G, RO

SD-11 Closeout Submittals

Facility Data Workbook, Construction Final; G, RO

Facility Document Set, Construction Final; G, RO

1.6 QUALITY ASSURANCE

1.6.1 Facility Data Project Execution Plan (FDPxP)

Provide the Government with a plan for the collection, organization, and turnover of the Facility Data deliverables to the Government. At a minimum, include the following items in the FDPxP:

1.6.1.1 Front Matter

Provide a Cover Page, Table of Contents, and Executive Summary/Objectives.

1.6.1.2 Project Information

List the Project Owner, Project Name, Project Location and address, Contract Type, Project Description, Project/Contract Number, Project Milestones.

1.6.1.3 Submittal Schedule

Identify delivery schedule for all deliverables in compliance with the submission requirements identified in this specification.

1.6.1.4 Personnel

Identify key personnel involved in the development of the Facility Data deliverables including Contractor and Government personnel.

1.6.1.5 Facility Data Workbook(s)

Identify Facility and Space Data as applicable at time of FDPxP submission. Individually list every asset group from the FDW Requirements that will require Facility Data collection. No attribute data is required at this time. Identify any asset groups from the FDW Requirements that are not required within the scope of this Contract. Document the version of FDW to be used through the duration of the project.

1.6.1.6 Facility Document Set(s)

Define structure and format of the submittal. Provide a comprehensive outline of the final FDS to be delivered. Organize the outline with headings, titles, and descriptions such that the Government may ascertain that working documents comply with the formatting requirements defined by this specification.

1.6.1.7 Protocols

Detailed procedures:

a. Facility Data documentation/collection process.

b. Facility Document Set production/development process.

c. Collaboration procedures including strategy, meetings, communication, and subcontractor/consultant involvement.

d. Quality Control, including site verification of FDW, as applicable.

e. File and folder naming structure.

f. Hardware and software being used for collection and organization of Facility Data. Identify type, format, and anticipated organization of digital storage media to be provided as part of required deliverables. Include means and methods for checking deliverables for malicious content.

1.6.2 Meetings

To assure that Facility Data requirements are being met through the duration of the project, organize the following meetings and discuss the subsequent topics:

1.6.2.1 Pre-Construction Meeting

At a minimum, discuss the following:

a. The requirement for Facility Data deliverables under this contract.

b. Primary roles and responsibilities associated with the development and delivery of the Facility Data deliverables.

c. Identify and agree upon a date and attendance list for the meetings described below:

1.6.2.2 FDPxP Coordination Meeting

a. Facilitate a meeting following submission and Government review of the FDPxP. Include the Facility Data Preparer(s), Quality Control (QC) Manager,Commissioning Authority (CA), Government's Facility Data Proponent, Contracting Officer's Representative, and Base Civil Engineer (BCE) Facilities Management Specialist (FMS).

b. The purpose of this meeting is to coordinate the efforts necessary by contract parties to ensure an accurate collection, preparation, quality control, and submittal of these deliverables.

c. The FDPxP serves as the primary agenda for this meeting. At a minimum, discuss the following:

(1) Processes and methods of gathering facility data during construction. Discuss and obtain special permissions and/or waivers as necessary (photo waivers, data encryption, etc.);

(2) Contractor Quality Control practices and procedures;

(3) Corrective actions necessary for Government approval of FDPxP;

(4) Necessity for additional or recurring Facility Data Coordination Meetings outside of those required by this specification, as requested by the Contractor. Intent of these meetings would be to maintain regular contact between responsible parties of the Contractor and Government with regard to development of the facility data deliverables. Conduct status meetings with a frequency agreed upon at this meeting.

1.6.2.3 Submittal Coordination Meeting

a. Facilitate a meeting following submission and Government review of each design or progress submittal of the Facility Data. Include the Facility Data Preparer(s), Designer of Record (DOR), Quality Control (QC) Manager, Commissioning Authority (CA), Government's Facility Data Proponent, Contracting Officer's Representative, and Base Civil Engineer (BCE) Facilities Management Specialist (FMS). Include Mechanical, Electrical, Plumbing, and Fire Protection subcontractors as applicable.

b. The purpose of this meeting is to demonstrate ongoing compliance with the requirements identified in this specification.

c. The applicable deliverables, along with Government remarks associated with review of these submittals serve as the primary guide and agenda for this meeting. At a minimum, discuss the following during this meeting:

(1) Review assets, applicable attributes, facility, and space data in FDW at time of submittal;

(2) Demonstrate Quality Control and site verification procedures, as applicable, by Contractor QC;

(3) Review contents and organization of FDS at time of submittal;

(4) Discuss Government review comments and/or unresolved items preventing completion and Government approval of the Facility Data Workbook and Facility Document Set.

1.6.3 Facility Turnover and Contract Closeout

Include the Facility Document Set, Construction Final as a deliverable in Facility Turnover and Contract Closeout procedures as defined in 01 78 39.00 24 AS-BUILT DRAWINGS.

1.6.4 Facility Data Workbook Quality Requirements

For each submittal, ensure that the information contained in the FDW(s) reflects the minimum content requirements defined in the PART 3 EXECUTION portion of this section. Ensure that information provided as part of the FDW(s) conforms to the standards described below:

a. Compile FDW(s) using approved spreadsheet templates. Do not alter the formatting or organizational layout of the templates in any way. For this Contract, templates are available for download from the USACE CAD/BIM Technology Center website, site information provided in the PART 2 PRODUCTS portion of this section.

b. Instructions for the proper maintenance and completion of these FDWs are contained in the FDW Requirements contained within the FDW template.

1.6.5 Facility Document Set Quality Requirements

Ensure that information provided as part of each FDS conforms to the electronic and data formatting standards identified below:

1.6.5.1 Document Files

Utilize PDF file format in accordance with ISO 32000-1 and ISO 19005-3 for all document-based files. Provide files from original sources, text-searchable, and saved in "Standard" (uncompressed) resolution. Bookmark and label files as defined in the PART 2 PRODUCTS portion of this section.

1.6.5.2 Photograph Files

If photographs are required, utilize JPEG file format for all photograph and image files. Provide full-color photos with photo resolution of not less than 4 megapixels and not more than 12 megapixels.

Provide a copy of any installation-specific letters or waivers allowing permission to take installed equipment photographs on this Contract. Waivers need not be attached to every photo, only one copy of each permission letter need be included in the Government deliverables.

1.6.5.3 Drawing Files

Provide all drawings required by this specification in full-size PDF format in accordance with ISO 32000-1 and ISO 19005-3. Produce PDF files from original sources, text-searchable, and saved in "Standard" (uncompressed) resolution whenever possible. Bookmark and label files as defined in the PART 2 PRODUCTS portion of this section.

Submission of scanned or photocopied drawing files is prohibited. Only vector-preserved PDF files are acceptable.

1.6.6 Facility Document Set Integrity Requirements

Ensure that information provided as part of each FDS conforms to the integrity standards identified below:

1.6.6.1 File Protection

Do not restrict data files, document files or photographic files from being printed, exported, modified or copied. Do not deliver files with any restrictions (expiration date, locks, etc.) for access, viewing, archiving, or editing.

1.6.6.2 Manufacturer-Specific Documents

Provide text-searchable, vector-based document files from the manufacturer's online or electronic documentation. Color documents are preferred. Provide documents specific to the product(s) installed under this Contract. When possible, do not submit document files containing multiple product catalogs from the same manufacturer, or product data from multiple manufacturers in the same file. Provide documents directly from the manufacturer whenever possible. Do not provide scanned copies of hardcopy documents.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver facility data submittals in an organized and legible manner. Provide submittals adhering to the requirements of described below.

1.7.1 Number of Copies

Provide three identical copies of disks for approval; for each submittal and each facility required. Provide on approved electronic media (one copy per disk or set of disks) as defined below. Provide submittal files on electronic storage media in compliance with the quality requirements identified in this specification.

1.7.2 Malicious Content

Scan all files for malicious viruses using a commercially available scanning program that is routinely updated to identify and remove current virus threats.

1.7.3 Storage Media

Provide facility data on disk-based (DVD-R/RW) media. Any deviations from the required storage media must be approved by the Government. Select and apply technology used for electronic data transmission to ensure that the full Facility Data submittal for each facility is provided on one single disk, whenever possible. When separation of the submittal is required, first separate the FDS and the FDW onto separate media. Second, separate FDS into logical segments or components. Any further divisions must be documented in the FDPxP and approved by the Government.

Provide Facility Data on disk-based (DVD-R/RW) media. Any deviations from the required storage media shall be approved by the Government. Select and apply technology used for electronic data transmission to ensure that the full Facility Data submittal for each facility is provided on one single disk, whenever possible. When separation of the submittal is required, first separate the FDS and the FDW onto separate media. Second, separate FDS into logical segments or components. Any further divisions must be documented in the FDPxP and approved by the Government.

a. Apply a label directly printed to storage media. Do not provide adhesive, paper-based labels. List the name of the facility, Project, Project location, Contract number, Designer of Record firm/Prime Contractor company's name, title of submission, and security classification (in accordance with the appropriate security classification labeling regulations) on the label. If multiple disks are provided, clearly document the contents of each disk on the label.

b. Include the name and contact information of the individual who produced the final data disk to ensure that any problems with the data or media can be easily resolved.

c. When browsed on any computer, the disk shall display the following folders and their associated content:

(1) Facility Data Workbook (containing 1 FDW per facility);
(2) Facility Document Set (containing 1 FDS per facility);
(3) FDPxP (containing 1 PxP per contract);
(4) Readme (Containing 1 TXT, PDF, or HTML file with general use information, organizational instructions, and basic preparer contact information. Include all information included on the storage media label).

PART 2 PRODUCTS

2.1 FACILITIES

Facilities that require individual (separate and complete) Facility Data deliverables as described in this specification are as follows:

a. Mission Operations Planning Facility (MPF)
b. Field Training Detachment Facility (FTD)

## 2.2 FACILITY DATA WORKBOOK(S)

Provide one compiled FDW for each facility identified above. Complete all portions of each FDW including facility, space, asset, and attribute data in compliance with the FDW Requirements. The current FDW template (.xlsm format) shall be downloaded from the USACE CAD/BIM Technology Center website at https://cadbimcenter.erdc.dren.mil.

### 2.2.1 Spaces

Provide data for all applicable spaces in the facility. Minimum space definitions are as follows:

a. Provide all rooms as defined in the design documents.
b. If not otherwise defined, provide a minimum of one "roof" space in the FDW.
c. If not otherwise defined, provide a minimum of one "site" space in the FDW.
d. Provide all spaces not otherwise described, but necessary to accurately indicate the location of all FDW assets required by this specification.

### 2.2.2 Assets

a. Compile an FDW that contains the maintainable and warrantable equipment (assets) associated with each facility. This includes assets in contract scope and within the project extents. See 01 78 39.00 24 AS-BUILT DRAWINGS and 01 78 23 OPERATION AND MAINTENANCE DATA for related requirements. Assets shall include but are not limited to those types described in the "Required Assets" portion of the FDW template and any additional assets defined in the FDPxP. FDW asset entries shall be individually itemized (instance-based). Entries indicative of multiple assets (type-based) are not allowed.

| SUPPLEMENTAL ASSET LIST (INCLUDE IN ADDITION TO "REQUIRED ASSETS" LISTED IN FDW TEMPLATE) | |
|---|---|
| Asset | Description/Example |
| Electrical Generators and Generator Sets | Emergency, standby, or continuous power generators and major supporting components. |

Assets applicable to the scope of this project shall be documented in the FDPxP.

b. Sub-component assets that are an integral and functional part of another component (e.g. An electric motor that serves as part of an air-handling unit) need not be duplicated or listed separately as its own asset.

c. Definitions, descriptions, and formatting requirements for these assets can be found in the FDW Requirements contained within the FDW template.

d. If an asset type is not included in the scope of the Project, no Facility Data (assets or attributes) are to be included in the FDW (even as a placeholder) for that asset type.

2.2.3 Attributes

a. Populate each individual asset with all required attributes defined in the "Required Attributes" portion of the FDW template.

b. Definitions, descriptions, and formatting requirements for these attributes can be found in the FDW Requirements contained within the FDW template.

c. If an attribute is not applicable, populate that field with "N/A." Do not leave it blank.

2.3 FACILITY DOCUMENT SET

2.3.1 Organization

Organize the FDS in a hierarchical manner as follows. Use electronic bookmarks to create an easily navigable document. The first and primary hierarchical level must contain the following bookmarks:

a. "O&M Data" - See subordinate hierarchical requirements in the "O&M DATA HIERARCHY" paragraph.

b. "Record Drawings" - See subordinate hierarchical requirements in paragraph RECORD DRAWINGS HIERARCHY.

2.3.1.1 O&M Data Hierarchy

Under "O&M Data" provide all Government-Approved O&M Data Packages as defined in 01 78 23 OPERATION AND MAINTENANCE DATA and as required by technical specifications contained within this contract. Further organize this information under the following hierarchical levels:

a. The contract specification and title under which the Data Package and the associated equipment or system references. (e.g. 26 23 00.00 40 - SWITCHBOARDS AND SWITCHGEAR)

b. The Data Package Number as defined in 01 78 23 OPERATION AND MAINTENANCE DATA. (e.g. Data Package 2)

2.3.1.2 Record Drawings Hierarchy

Under "Record Drawings" provide an electronic copy of the Government-Approved record drawings, as specified in 01 78 39.00 24 AS-BUILT DRAWINGS, for the project in PDF format. Further group discipline sheets under the following hierarchical levels:

a. The full discipline heading represented by the contents of the sheet and as shown in the Record Drawing Sheet Index. Organize these headings in the order that the drawings set is organized. (General, Civil, Structural, Architectural, Interiors, Plumbing, Mechanical, Electrical, Telecommunications, etc.)

b. The Sheet ID and Sheet Name as found in the Record Drawing Sheet Index and in accordance with the AEC CAD Standard referenced in 01 78 39.00 24 AS-BUILT DRAWINGS. (e.g. G-001 - LEGEND; CS101 - SITE PLAN AREA 101; A-101 - OVERALL FIRST FLOOR PLAN; P-601 - FIRST FLOOR DWS WATER RISER DIAGRAM, etc.)

PART 3 EXECUTION

3.1 CONSTRUCTION PROGRESS SUBMITTALS

Submit the FDW and FDS construction progress submittals together. Meet the following completeness and formatting requirements listed below:

a. Provide Facility Data Workbook, Construction Progress submittal(s) when all assets are identified, but not later than 90days prior to Beneficial Occupancy Date (BOD) as identified in the Government-Approved construction schedule. Clearly identify any assets or asset groups missing in the "variations" section of the ENG Form 4025 Transmittal Form provided with the submittal. Populate assets with any front-loaded attribute data that is available at the time of asset input. See the FDW Requirements contained within the FDW template for a list of attributes to be completed for this submittal.

b. Submit individual FDW templates for each facility identified in the "FACILITIES" paragraph. While FDWs are not required to be complete for this submittal, any data provided shall be accurate and formatted correctly according to the FDW Requirements.

c. Submit a sample or working Facility Document Set, Construction Progress submittal containing "draft" or "example" documents that are organized in the manner defined by this specification. Draft or example documents need not be technically accurate or complete in their content, but defined and separated in a manner such that all organizational and formatting requirements defined by this specification may be evaluated.

3.2 CONSTRUCTION FINAL SUBMITTALS

Submit the FDW and FDS construction final submittals as they are completed. Coordinate the Facility Data Workbook, Construction Final submittal with data verification procedures as defined in the accepted FDPxP. Provide the Facility Document Set, Construction Final submittal only after Government acceptance of its individual components as defined by 01 78 39.00 24 AS-BUILT DRAWINGS and 01 78 23 OPERATION AND MAINTENANCE DATA.

3.3 FACILITY DATA WORKBOOK VERIFICATION

Verify the FDW through the quality control personnel and procedures as defined in the FDPxP. Coordinate and conduct verification with commissioning procedures defined in 01 91 00.15 10 TOTAL BUILDING COMISSIONING. One-hundred percent accuracy of FDW information is required for Government acceptance of the Facility Data Workbook, Construction Final submittal.

-- End of Section --

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DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 36.00 24

WARRANTY OF CONSTRUCTION

**4/07**

PART 1 GENERAL

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SECTION 01 78 36.00 24

WARRANTY OF CONSTRUCTION
**4/07**

PART 1 GENERAL

1.1 WARRANTY OF CONSTRUCTION

(a) Foremost and in addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph (i) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

(b) This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

(c) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(1) The Contractor's failure to conform to contract requirements; or

(2) Any defect of equipment, material, workmanship, or design furnished by the Contractor.

(d) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause.

(e) The Contractor's warranty with respect to work restored, repaired or replaced will run for 1 year from the date of restoration, repair or replacement. This provision applies equally to all items restored, repaired, or replaced under paragraph (c) and (d) above.

(f) The Government will notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage. Repair work necessary to correct a warranty condition which arises to threaten the health or safety of personnel, the physical safety of property or equipment, or which impairs operations, habitability of living spaces, etc., will be performed by the Contractor on an immediate basis as directed verbally by the Government. Written verification will follow verbal instruction.

(g) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of verbal or written notice, the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

(h) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

(1) Obtain all warranties that would be given in normal commercial practice;

(2) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

(3) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

(i) In the event the Contractor's warranty under paragraph (b) of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

(j) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.

(k) This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

1.2 ADDITIONAL WARRANTY REQUIREMENTS

1.2.1 Performance Bond

(a) It is understood that the Contractor's Performance Bond will remain effective for one (1) year from the date of acceptance.

(b) If either the Contractor or his representative doesn't diligently pursue warranty work to completion, the contractor and surety will be liable for all costs. The Government, at its option, will either have the work performed by others or require the surety to have it done. Both direct and administrative costs will be reimbursable to the Government.

1.2.2 Pre-Warranty Conference

(a) Prior to contract completion and at a time designated by the Contracting Officer or his authorized representative, the Contractor shall meet with the Contracting Officer or his authorized representative to develop a mutual understanding with respect to the requirements of the Paragraph: WARRANTY OF CONSTRUCTION. Communication procedures for Contractor notification of warranty defects, priorities with respect to the type of defect and other details deemed necessary by the Contracting Officer or his authorized representative for the execution of the construction warranty shall be established/reviewed at this meeting.

(b) In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor will furnish the name, telephone number and address of the service

representative which is authorized to initiate and pursue warranty work action on behalf of the Contractor and surety. This single point of contact will be located within the local service area of the warranted construction, will be continuously available, and will be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any Contractual responsibilities in connection with the paragraph: WARRANTY OF CONSTRUCTION.

(c) Local service area is defined as the area in which the contractor or his representative can meet the response times as described in paragraph 1.2.4 and in any event shall not exceed 200 miles radius of the construction site.

1.2.3 Equipment Warranty Identification

The Contractor shall provide warranty identification tags on all mechanical and electrical equipment installed under this contract. Tags and installation shall be in accordance with the requirements of Paragraph: EQUIPMENT WARRANTY IDENTIFICATION TAGS.

1.2.4 Warranty Service Calls

The Contractor or his local service representative will respond to the site, to a call within the time periods as follows: Four (4) hours for Heating, Air Conditioning, Refrigeration, Air Supply and Distribution, Critical Electrical service Systems and Food Service Equipment and Twenty-Four (24) hours For All Other Systems.

1.2.5 Equipment Warranty Booklet

At or before 30 days prior to final inspection and acceptance of the work, the Contractor shall submit the data mentioned as follows:

The Contractor shall provided a Booklet, which consists of a listing of all equipment items (see paragraphs a. and b. below) which are specified to be guaranteed along with the warranty papers for each piece of equipment. Three (3) legible bound copies of the booklet shall be submitted for approval and shall be indexed alphabetically by equipment type. For each specific guaranteed item, the name, address, and telephone number shall be shown on the list for the subcontractor who installed equipment, equipment supplier or distributor, and equipment manufacturer. Completion date of the guarantee period shall correspond to the applicable specification requirements for each guaranteed item. The names of service representatives that will make warranty calls along with the day, night, weekend and holiday contacts for response to a call within the time period specified shall also be identified.

a. For Equipment in Place: The equipment list shall show unit retail value and nameplate data including model number, size, manufacturer, etc. This would include capital equipment and other nonexpendable supplies of a movable nature that are not affixed as an integral part of the facility and may be removed without destroying or reducing the usefulness of the facility. Some examples are spare parts, special tools, manufacturing equipment, maintenance equipment, instruments, installed under this contract.

b. For Installed Building Equipment: The equipment list shall show unit retail value and nameplate data including model number, size,

manufacturer, etc. This would include items of equipment and furnishings (including material for installation thereof), which are required to make the facility usable and are affixed as a permanent part of the structure. Some examples are plumbing fixtures, laboratory counters and cabinets, kitchen equipment, mechanical equipment, electrical equipment, and fire protection systems installed under this contract.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-11 Closeout Submittals

Equipment Warranty Booklet

1.4 EQUIPMENT WARRANTY IDENTIFICATIONS TAGS

1.4.1 GENERAL REQUIREMENTS

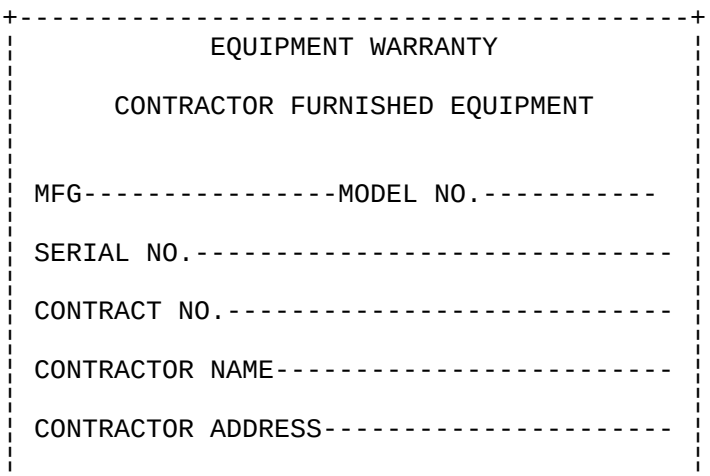
Provide warranty identification tags on all Contractor and government furnished equipment which is Contractor installed.

1.4.1.1 Tags and Information

The tags and information shall be similar in format and size to the exhibits provided by this specification, and shall be suitable for interior and exterior locations, resistant to solvents, abrasion, and to fading caused by sunlight, precipitation, etc. These tags shall have a permanent pressure- sensitive adhesive back, and shall be installed in a position that is easily (or most easily) noticeable. If the equipment surface is not suitable for adhesive back, Contractor shall submit his alternative to the Contracting Officer's Authorized Representative for review and approval. Contractor furnished equipment that has differing warranties on its components will have each component tagged.

1.4.1.2 Tags for Warranted Equipment

The tag for his equipment shall be similar to the following:



| CONTRACTOR TELEPHONE---------- |
| --- |
| CONTRACTOR WARRANTY EXPIRES---------- |
| IN CASE OF WARRANTY ACTION FIRST CONTACT |
| BCE AT [TELEPHONE NUMBER] |

| EQUIPMENT WARRANTY |
| --- |
| GOVERNMENT FURNISHED EQUIPMENT |
| MFG _____ MODEL NO._____ |
| SERIAL NO. _____ |
| CONTRACT NO. _____ |
| DATE EQUIP PLACED IN SERVICE _____ |

1.4.1.3 Exclusion to Providing Tags

If the manufacturer's name (MFG), model number and serial number are on the manufacturer's equipment data plate and this data plate is easily found and fully legible, this information need not be duplicated on the equipment warranty tag. The Contractor's warranty expiration date and the final manufacturer's warranty expiration date will be determined as specified by the Paragraph "WARRANTY OF CONSTRUCTION".

1.4.2 EXECUTION

The Contractor will complete the required information on each tag and install these tags on the equipment by the time of and as a condition of final acceptance of the equipment. The Contractor shall be responsible for scheduling acceptance inspection with the Contracting Officer (verbal and written notification required). If this inspection is delayed by the Contractor, the Contractor shall, at his own expense, update the in-service and warranty expiration dates on these tags.

1.4.3 Equipment Warranty Tag Replacement

Under the terms of this contract, the Contractor's warranty with respect to work repaired or replaced shall run for one year from the date of repair or replacement. Such activity shall include a data warranty identification tag on the repaired or replaced equipment. The tag shall be furnished and installed by the Contractor, and shall be similar to the original tag, except that it should include the scope of repair and that the contractor's warranty expiration date will be one year from the date of acceptance of the repair or replacement. In the case of repair, the repair only will be covered by the extended warranty. In the case of replacement of a component, the component only will be covered by the extended warranty. In these cases, the original tags will not be removed,

but an additional tag will be installed for the repair or component replacement.

PART 2 NOT USED

PART 3 NOT USED

-- End of Section --

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SECTION 01 78 39.00 24

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ATTACHMENTS:

Modifications and Title Block Examples

-- End of Section Table of Contents --

SECTION 01 78 39.00 24

AS-BUILT DRAWINGS
02/22

PART 1 GENERAL

Attachments: Modifications and Title Block Examples

1.1 DEFINITIONS

The definitions listed below form a part of this specification.

1.1.1 Red-Line Drawings

Contract drawings marked-up during construction to show actual work performed to include necessary sketches, modification drawings, shop drawings and notes.

1.1.2 As-Built Drawings

Professionally-finished paper drawings and electronic CAD Files developed from the contract drawings that include all of the information from the redline drawings and suitable for half-size reproduction. Building Information Modeling (BIM) files are considered a part of As-Built Drawings. See Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS for additional requirements and deliverables.

1.1.3 Black-Line Drawings

Electronic CAD files that can be used to produce high quality drawings.

1.1.4 Full-Size Drawings

22 inches x 34 inches nominal size drawings with all details visually readable so that half-size plot will fit on 11 inches x 17 inches cut sheets.

1.1.5 Modification Circle

A circle with a horizontal line through the center to identify modification changes on the drawings. The top half will contain the letter "R" with the bottom half containing the Modification number, unless directed otherwise. The lettering standard will be 1/8-inch Arial.ttf.

1.1.6 Electronic CAD Files

See Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS.

1.1.7 Building Information Modeling (BIM) Files

See Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS for definition.

1.1.8 Geodetic Datum

See Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS for definition.

1.1.9 State Plane Coordinate System (SPCS)

See Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS for definition.

1.2 REFERENCES

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| ERDC/ITL TR-19-7 | (2019) A/E/C CAD Standard - Release 6.1 |
| EM 1110-1-2909 | (2012) Geospatial Data and Systems |

1.3 SUSTAINABILITY REQUIREMENTS

Materials in this technical specification may contribute towards contract compliance with sustainability requirements. See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for project requirements.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

50 Percent Preliminary As-Built Drawings; G-DO

100 Percent Preliminary As-Built Drawings; G-DO

SD-11 Closeout Submittals

Final As-Built Drawings; G-DO

Sustainability Documentation; G-RO

1.5 GENERAL REQUIREMENTS

1.5.1 As-built Drawings

Upon award of this contract, the Government will provide the Contractor PDFs of the Contract drawings. Once the Contractor makes hardcopy distribution of these drawings in accordance with Section 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS, the Government will provide the Contractor with Govenment-furnished electronic CAD Files and BIM Files in the formats indicated in Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS.

Maintain electronic CAD files, BIM files and Red-Line Drawings showing As-Built conditions. Provide as-built Building BIM model in compliance with USACE Minimum Modeling Matrix (M3) for Level of Detail (LOD) and

element Grade for "Record Models" as referenced in Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS. Use the ERDC/ITL TR-19-7 USACE A/E/C CAD Standard for the As-Built drawings. Obtain the A/E/C Standards in effect at time of Contract Award. The A/E/C Standards are available at:

https://cadbimcenter.erdc.dren.mil/

(New users will be required to register. See "New User Registration" at the website indicated above.)

Obtain the required CAD software and BIM software for Contractor use. **Do not convert electronic drawing files from one software language to another unless as specifically allowed or required in Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS.** Show the transmittal requirements for the As-built Drawings as activities on the Contractor-prepared project schedule.

Show all changes from the contract drawings on the as-builts. Accurately and neatly record all changes on the As-built drawings using the same symbols, terminology, and general quality as the original set of contract drawings. Show all changes on all drawings that are affected by the change. Changes include: actual work performed, deviations resulting from Government responses to Requests for Information or Serial letters, surveys, shop drawings, descriptive changes, sketch changes, and modifications to the contract. Show all systems designed or enhanced by the Contractor such as HVAC control system, fire alarm system fire sprinkler system, and irrigation sprinkler system, on the As-built drawings. Where contract drawings or specifications allow for options, only show the option selected and actually constructed on the As-Built Drawings.

### 1.5.2 Red-Line Drawings

Update Red-Line Drawings throughout the construction phase of the contract showing all changes that will be shown on the final as-builts. Place all as-built conditions on the Red-Line Drawings **within two (2) days** after completing the work activity or it shall be entered on the deficiency tracking system (see Section 01 45 00.00 10, QUALITY CONTROL). The Government will consider the Contractor to not be making satisfactory progress and will withhold funds from progress payments if the Contractor does not completely and accurately update the as-built drawings.

Provide red-line drawings in an electronic format.

#### 1.5.2.1 Electronic Red-Lines

Make electronic red-line drawings available to the COR at all times through a Local Area Network (LAN) or Internet connection. The connection shall have a download transfer rate not less than 10 Megabit/second (~1.250 Megabytes/second) and an upload transfer rate of not less than 1 Megabit/second (~124 kilobytes/second) in order to facilitate the timely access of drawing files. Make backups of all the electronic drawings at the close of business on the final day of work each week on a durable digital media such as removable hard-drive, tape drive, or optical disk. Preserve each weekly file system backup over the course of the project and do not overwrite; label the file folders or individual media with the date of backup. Store the weekly backup media in a fireproof and waterproof safe in a locked room of the Contractor's trailer. Electronically provide

the COR with updated PDF drawings on a monthly basis. Show all changes to the electronic drawings with clouding and in accordance with ERDC/ITL TR-19-7.

1.5.3 GeoDataBase

Provide digital media containing a SDSFIE/FGDC GeoReferenced personal GeoDataBase, in accordance with the requirements of this section and EM 1110-1-2909, unless otherwise directed by the Contracting Officer.

See Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS for applicable references and requirements.

1.5.4 Sustainability Documentation

All Sustainability documentation that was submitted in the USGBC templates and any other documentation which supports the templates and indicates compliance with related Federal Mandates shall be submitted once Sustainability Documentation is finalized. See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for detailed requirements. Submit all Sustainability documentation within 120 days after the final inspection. Place the Sustainability documentation on two DVDs and send one copy sent to the COR and the other to the Omaha District Office (ATTN: Patricia Lambert, CENWO-CDS-C).

1.6 PAYMENT

In accordance with the clause "Payment Under Fixed - Price Construction Contracts", cost load closeout activities amounts in accordance with Section 01 32 01.00 10 PROJECT SCHEDULE not less than $35,000 or 1 percent of the present contract value, which ever is greater, up to $200,000. This amount will be withheld from payment for the creation of As-Built Drawings until Final As-Built Drawings and GeoDatabase Files are delivered to and accepted by the COR.

1.7 CONTRACTOR PERFORMANCE RATING

The Government will evaluate the Contractor's performance in CPARS (Contractor Performance Assessment Reporting System) at intervals of no more than 365 days during the period of performance and complete the final evaluation within 120 days of completion of the project. The timeliness and quality of As-Built drawings submittals, Final As-built Drawings, Red-line drawings, Sustainability Documentation, and GeoDataBase Files will be an important factor in determining the assigned rating for the Schedule evaluation area. If the Contractor fails to submit complete and accurate Final As-Built Drawings and GeoDataBase Files within sixty (60) calendar days of turning the completed project over to the Using Service, this failure will be noted in the comments under the Schedule evaluation area and may result in a lower rating for this area. Repeated failure to submit correct and accurate As-Built drawings submittals, Final As-built Drawings, Red-line drawings, Sustainability Documentation, and GeoDataBase Files may also result in lower ratings for the Quality and Management evaluation areas. The Contractor shall receive an Unsatisfactory rating for Sustainability documentation if Sustainability documentation is not submitted within 120 days after the final inspection.

## 1.8 TRANSMITTAL OF AS-BUILT DRAWINGS

### 1.8.1 Optional As-built Drawings Sample

Optionally submit a sample of preliminary as-built drawings to the Omaha District Office that will be reviewed for formatting purposes. Include five distinct sheets from the project drawings in this submittal. Send this optional submittal on approved digitial media to the Omaha District Office (ATTN: Patricia Lambert, CENWO-CDS-C) and include the following:

a. Electronic CAD/BIM/CIM Files
b. Individual PDF Drawings
c. One (1) Combined Set of full-size PDF Drawings with bookmarks for each sheet

### 1.8.2 50 Percent Preliminary As-Built Drawings

Submit the 50 Percent Preliminary As-Built Drawings within thirty days after 50% physical completion unless otherwise directed by the COR. The Government will review these drawings for technical content and formatting requirements. Include all changes up to the time of submission with "clouding" around the changes on the electronic CAD Files. Submit all drawings contained in the complete project set of drawings plus any additional drawings with the 50 Percent Preliminary As-Built Drawings. Include the following on the approved digital media for the 50 Percent Preliminary As-Built Drawings (ATTN: Patricia Lambert, CENWO-CDS-C):

a. All documents and files required under "Advanced Modeling Submittal Packaging" paragraph of Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS.
b. Current electronic red-line drawings for reviewing purposes.

If a resubmittal is required, resubmit within fifteen days after receiving comments back from the Government. Failure to submit the 50 Percent Preliminary As-Built Drawings by the specified time will result in the Government not considering the Contractor to be making satisfactory progress on the project and witholding funds from the progress payments.

### 1.8.3 100 Percent Preliminary As-Built Drawings

The 100 Percent Preliminary As-Built Drawings include all changes to the drawings as specified. The 100 Percent Preliminary As-Built Drawings will be reviewed for technical content and formatting requirements. Within thirty (30) days after the final inspection, submit 100 Percent Preliminary As-Built Drawings indicating all as-built changes with "clouding" on all of the project drawings. Submit all drawings contained in the complete project set of drawings plus any additional drawings with the 100 Percent Preliminary As-Built Drawings. The COR may grant the Contractor additional time if the Contractor is making reasonable progress on the as-builts, in the sole judgment of the COR. Do not submit the Final As-Built Drawings until the 100 Percent Preliminary As-Built Drawings are approved. Include the following on the approved digital media for the 100 Percent Preliminary As-Built Drawings (ATTN: Patricia Lambert, CENWO-CDS-C):

a. All documents and files required under "Advanced Modeling Submittal Packaging" paragraph of Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS.
b. Current electronic red-line drawings for reviewing purposes.

Also include one hardcopy set of half-size black-line drawings on bond paper.

1.8.4 Final As-Built Drawings

Produce Final As-Built Drawings without "clouding". Include all changes shown on the 100 Percent Preliminary As-Built Drawings plus any additional required changes on the Final As-Built Drawings. Submit all drawings contained in the complete project set of drawings plus any additional drawings with the Final As-Built Drawings. Submit the Final Drawings no later than ten days after the 100 Percent Preliminary As-Built Drawing submittal is approved. The COR may grant additional time if the Contractor is making reasonable progress on the as-builts. Send the following to the COR:

Three approved digital media containing the following:

a. All documents and files required under "Advanced Modeling Submittal Packaging" paragraph of Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS.
b. Current electronic red-line drawings for reviewing purposes.

Include one hardcopy set of half-size black-line drawings on bond paper and one full-size set of mylar As-built drawings in documents sent to COR.

Send one copy of the digital media only to the Omaha District Office (ATTN: Patricia Lambert, CENWO-CDS-C).

1.9 AS-BUILT DRAWINGS FORMAT REQUIREMENTS

1.9.1 General Formatting

Prepare As-built Drawings in accordance with ERDC/ITL TR-19-7 requirements and/or match the detail shown on the contract drawings. Include all of the requirements below on the drawings:

a. Update the drawing index when drawings are added.
b. When opened, ensure the view is zoomed to fit the border.
c. Reference a border supplied by the CAD/BIM Technology Center ( https://cadbimcenter.erdc.dren.mil/) placed in the layout/sheet model at a scale of 1 at the location (0,0) in all files.
d. Delete all unnecessary information outside the border.
e. Purge/compress all files.
f. Include all reference files in appropriate folders within the provided workspace.
g. Use the Arial.ttf font for all text.
h. Provide an ASCII text file with the following information: the name and phone number of the person we need to contact if we have problems, and the version of the CAD software used to create and/or work on the drawings.
i. (CAD only) Supply pen tables for plotting.
j. (CAD only) Provide each sheet/design with its own file and file name with only one layout/sheet per design file.
k. (CAD only) Accomplish half toning by using the color 8 and setting the pen table to plot color 8 to half tone.
l. The file name is the project code followed by the sheet identification number. Include the file name in the border on every

sheet and match the name of the file on the Digital Media. The project code is ELA6.
m. Include the File number in the border on every sheet. The file number is: (the Contract number, to be provided at award).
n. Change the cover sheet from "Contract Award Set" to "As-Built Record Set" with month & year completed.
o. Show drawing changes by "clouding" the affected area in layer "G-ANNO-REVS" (CAD only) in the drawing file of all preliminary as-builts and redlines. For BIM, accomplish clouding commensurate with the available tools.
p. Place all submitted Electronic CAD Files and PDF drawings under a folder labeled "As-Built" on the submitted Digital Media.
q. Include the name of the project, location, project code, solicitation number, contract number, and words detailing which submittal it is on both the Digital Media case and Digital Media. Title the Final As-builts Drawings "As-Built Record Set".
r. Do not use zipped or compressed folders on any of the As-built submittals.
s. On the cover sheet add or revise text to read "This folio includes all reissued and descriptive amendments, RFIs, and modifications."
t. Place the Electronic CAD native design files and PDF drawings in separate folders on the Digital Media.

1.9.2 Title Block

Fill in and correct all information in the title block. Include all the requirements below in the title block.

a. Add "RECORD DRAWING" text below the title block on the right side of the drawing on all sheets.
b. Add the date in the revision box for modifications from Block 3 of Form SF-30.
c. State "REVISED TO SHOW AS-BUILT CONDITIONS" and date the top line of the revision box. Use a "-" for the "Mark".
d. Enter the month and year as-builts were completed in the date box.
e. Show the contract number and the solicitation number (if available) on all sheets.
f. Properly identify additional word abbreviations, not found on the abbreviation sheet but necessary to describe the work, and incorporate with the other standard word abbreviations.
g. Properly note modifications in the title block in accordance with paragraph "Modification Changes" below.

1.9.3 Modification Changes

Include all modification changes on the as-built drawings. At a minimum, include all revised and reissued sheets, descriptive changes, sketches, etc. Change other sheets as appropriate with any modification change that also affects other sheets other than the one referenced with the modification. Typically, modification changes can be done by following the descriptive change included with the modification, but may require additional effort depending on the change and level of detail of the modification change. Post modifications in accordance with the following:

a. Follow directions in the modification for posting all changes.
b. Post all modifications to the contract in chronological order.
c. Show the last modification number completed on the sheet with the modification circle in the top right corner of the "Project Title" and "Project Location" box.

d. Place a modification number in the revision box over column entitled "Mark" for all modifications to plans, sections, or details. Use the statement "GENERAL REVISIONS" when applicable.
e. Make the Modification Circle size 1/2-inch diameter unless the area where the circle is located is crowded. Use a smaller size circle for crowded areas.
f. Place a Modification Circle at the location of each deletion.
g. For all new details or sections that are added to a drawing, place a Modification Circle by the detail or section title.
h. For changes to a drawing, place a Modification Circle by the title of the affected plan, section or detail titles (each location).
i. For changes to schedules on drawings, place a Modification Circle either by the schedule heading or by the change in the schedule.

1.9.4 Legends

Do not use symbols which conflict with those on the original contract legend sheet. Properly identify and add to the legend sheet or supplemental legend additional symbols necessary to depict any additional work items. Those projects that do not have legend sheets may use supplemental legends on each sheet where symbol is shown.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

Make revisions to and maintain the red-line and as-built drawings to the same level of detail as shown on the original contract drawings. Provide any additional drawings as required to display all details. In addition, prepare the GeoDatabase Files as specified above and submit in conjunction with the As-Built drawings.

3.2 SITE WORK

3.2.1 Utilities

Show all utilities whether active or abandoned on the as-built drawings and include all those shown on the original contract drawings or found on-site. Show the type of utility, location, general direction, size, material make-up and depth. Show the location and description of any utility line or other installations of any kind known to exist within the construction area. Include dimensions to permanent features as part of the location. Locate during installation all new underground utility lines (including electrical power and communications, gas, water, sanitary sewer, storm drains, roof drains and culverts). Survey pipe invert of gas, water, sanitary sewer, storm drains, roof drains and culverts and top of duct bank of electrical power and communications lines and associated fixtures (valves, manholes, test points, meters, cathodic protection points, tanks, ground points, and all point features along the new utility lines). Survey storm drains and sanitary sewer lines where pipes enter manholes and inlets and at 100-foot maximum intervals along the line. Survey the inverts of all cleanouts and tees. Survey inverts at each end of culverts. Survey electrical power, communications, gas and water lines at all manholes, tees, valves, corners, changes in direction and at intervals along the line to accurately depict the location of the line in both horizontal and vertical directions (50-foot maximum interval). Make the horizontal and vertical accuracy such that 100% of the points are +

0.25' of their absolute position.

3.2.2 Structures

Show structures above and below ground. Show the size, material make-up, location, height, and/or depth. Show rim elevation and invert elevations as applicable at manholes. Show electrical equipment, guy wires, and voltage rating on power poles.

3.2.3 Grades

Correct grade or alignment of roads, structures, or utilities if any changes were made from the contract drawings. Correct elevations if changes were made in site grading. If any grades were finalized outside of the respective grades tolerances, show that new grade on the as-builts.

3.3 STRUCTURAL

3.3.1 Steel/Concrete

Incorporate shop drawings that deviate from the contract drawings in the As-Built Drawings.

3.4 MECHANICAL

3.4.1 Ductwork

Show ductwork to reflect actual installation and duct size. Show ductwork routing changes.

3.4.2 Plumbing

Show piping and fixtures to reflect the type of material, size and the route or location.

3.5 ELECTRICAL

3.5.1 PANELS

Revise all contract drawing panel schedules to show as-built conditions. Ensure home-run circuit designation on electrical drawings accurately correspond to the as-built panel schedules.

3.5.2 Controls

Revise all control diagrams in contract drawings to reflect as-built conditions and setpoints.

3.6 CONTRACTOR SHOP DRAWINGS

Incorporate contractor shop drawings, which supersede data on the contract plans and/or additional drawings, prepared by the Contractor, into the As-Built Drawings. Include the designer's name on the As-Built Drawings for any design plans prepared by the Contractor.

-- End of Section --

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RECORD DRAWING

DEFINITIONS OF REVISIONS:

1. LAST ENTRY IN DESCRIPTION BOX SHALL APPLY TO AS-BUILT CONDITIONS
2. REVISIONS BY MODIFICATION. (AFTER AWARD OF CONSTRUCTION CONTRACT).
3. METHOD OF ADDING NEW DRAWING BY MODIFICATION.
4. REVISIONS BY AMENDMENT WHEN WRITTEN "WORD DESCRIPTIVE" AMENDMENT IS ISSUED AND DRAWINGS ARE POSTED FROM WRITTEN DESCRIPTIONS AFTER THE ISSUE DATE.
5. REVISIONS BY AMENDMENT WHEN DRAWING IS TO BE RE-ISSUED.
6. METHOD OF ADDING NEW DRAWING BY AMENDMENT.
   NOTE: DELTA NUMBER MATCHES AM. NUMBER

INSTRUCTIONS FOR NOTING REVISIONS:

1. ADD THE REVISION DESCRIPTION (EITHER CHANGE ORDER, AMENDMENT OR MODIFICATION DESCRIPTION AS APPLICABLE).
2. ADD THE PROPER REVISION SYMBOL TO THE LEFT OF THE REVISION NOTATION.
3. ADD THE PROPER AMENDMENT OR MOD. SYMBOL NEAR EACH REVISED ITEM IN THE BODY OF THE DRAWING.
4. WHEN ADDING A NEW DRAWING TO SHOW SUPPLEMENTAL DATA, USE SAME DRAWING NUMBERS AS DRAWING WITH SIMILAR SUBJECT MATTER AND ADD AN ALPHABETICAL SUFFIX TO THE SHEET NO. THIS DRAWING SHOULD BE ADDED TO THE INDEX OF DRAWINGS IN ITS PROPER PLACE ACCORDING TO THE SHEET NUMBER.
5. FOR MODIFICATION ONLY:
   ADD A ½ INCH ENCIRCLED (R / X) INSIDE OF TITLE BLOCK SHOWING THE LAST MOD NUMBER COMPLETED.
   ALSO USE THIS NEAR EACH REVISED ITEM IN THE BODY OF THE DRAWING.

REVISION DESCRIPTIONS - FOR AMENDMENTS AND/OR MODIFICATIONS:

| | |
|---|---|
| AM. #000X - CHANGE ORDER | (DESCRIPTION & REASON FOR CHANGE ARE THE SAME AS AMENDMENTS LISTED BELOW) |
| AM. #000X - REISSUED FOR CLARITY | (DRAWING IS HARD TO READ - BLURRY) |
| AM. #000X - GENERAL REVISIONS | (THIS WOULD BE FOR ANY RE-ISSUED DRAWINGS, TYPICAL CHANGES OR CORRECTIONS) |
| AM. #000X - REVISED AND REDRAWN | (MAJOR OVERHAUL OF THE DRAWING, TOO MANY CHANGES TO INDICATE INDIVIDUALLY) |
| AM. #000X - NEW DRAWING ADDED | (DRAWING THAT WAS NOT ORIGINALLY INCLUDED IN THE ADVERTISED SET) |
| REVISED IN ACCORDANCE WITH AM. #000X | (THIS IS FOR DESCRIPTIVE CHANGES THAT WENT OUT IN THE AMENDMENT - DRAWING IS NOT RE-ISSUED - AND THE CHANGES ARE THEN LATER POSTED TO THE DRAWINGS AS IT BECOMES A CONTRACT SET) |
| --- (DASH) | REVISED TO SHOW AS-BUILT CONDITIONS |

SHEET ID

PROJECT/CONTRACT LOCATION 1
PROJECT/CONTRACT DESCRIPTION 2
(R / 5)

SHEET TITLE 1
SHEET TITLE 2
SHEET TITLE 3

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
1616 CAPITOL AVE.
OMAHA, NE 68102

| | |
|---|---|
| DESIGNED BY: J. DESIGNER | ISSUE DATE: MMMMMMMMM YYYY |
| DRAWN BY: J. DRAWER | SOLICITATION NO.: XXXXXX-XX-X-XXXX |
| CHECKED BY: J. CHECKER | CONTRACT NO.: XXXXXX-XX-X-XXXX |
| SUBMITTED BY: J. SUBMITTER | FILE NUMBER: |
| SIZE: ANSI D | FILE NAME: |

| MARK | DESCRIPTION | DATE |
|---|---|---|
| - | REVISED TO SHOW AS-BUILT CONDITIONS | 10-18-2023 |
| R-4 | MOD. #0004 - GENERAL REVISIONS | 10-02-2023 |
| R-1 | MOD. #0001 - NEW DRAWING ADDED | 09-20-2023 |
| 4 | REVISED IN ACCORDANCE WITH AM. #0004 | 06-17-2023 |
| 3 | AM. #0003 GENERAL REVISIONS | 05-12-2023 |
| 2 | AM. #0002 GENERAL REVISIONS | 03-17-2023 |
| 1 | AM. #0001 NEW DRAWING ADDED | 02-17-2023 |
| 1 | CHG. ORDER #0001 GENERAL REVISIONS | 02-09-2023 |

US Army Corps of Engineers®

**SHEET 1 of 2**

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NWO CAD MANAGER 01/27/2023 MICROSTATION

## TITLE BLOCK INFORMATION KEY

**SHEET IDENTIFICATION NUMBER:**

- DISCIPLINE DESIGNATOR w/ Level 2 Designator *(see A/E/C CADD STANDARD for Level 2 Designator)*
- SHEET TYPE DESIGNATOR
- SHEET SEQUENCE NUMBER

M - 2 0 1

| | |
|---|---|
| **DESIGNED BY:** FIRST INITIAL. LAST NAME OF DESIGNER | **ISSUE DATE:** AUTO GENERATED INFORMATION DO NOT EDIT |
| **DRAWN BY:** FIRST INITIAL. LAST NAME OF CAD TECH OR DESIGNER | **SOLICITATION NO.:** THIS NUMBER IS ASSIGNED BY CONTRACTING AND ADDED TO TITLE BLOCK AT THE TIME OF PLOTTING ADVERTISEMENT DRAWINGS |
| **CHECKED BY:** FIRST INITIAL. LAST NAME OF REVIEWER | **CONTRACT NO.:** THIS NUMBER IS ASSIGNED BY CONTRACTING AND ADDED TO TITLE BLOCK AT THE TIME OF PLOTTING CONTRACT AWARD DRAWINGS |
| **SUBMITTED BY:** FIRST INITIAL. LAST NAME OF REVIEWER/DESCIPLINE SECTION CHIEF | **FILE NUMBER: **** THIS NUMBER IS ASSIGNED BY PROJECT COORDINATOR AND ADDED TO TITLE BLOCK AT THE BEGINNING OF THE PROJECT |
| **SIZE:** AUTO GENERATED INFO. DO NOT EDIT | **FILE NAME:** NAME OF CADD FILE: FILE NAMES SHOULD BEGIN WITH THE PROJECT CODE ASSIGNED BY THE CAD MANAGER. SEE A/E/C CADD STANDARDS FOR SHEET FILE NAMING CONVENTION |

| MARK | DESCRIPTION | DATE |
|---|---|---|
| - | REVISED TO SHOW AS-BUILT CONDITIONS | 10-18-2023 |
| R-4 | MOD. #0004 - GENERAL REVISIONS | 10-02-2023 |
| R-1 | MOD. #0001 - NEW DRAWING ADDED | 09-20-2023 |
| 7 | REVISED IN ACCORDANCE WITH AM. #0004 | 06-17-2023 |
| 6 | AM. #0003 GENERAL REVISIONS | 05-12-2023 |
| 5 | AM. #0002 GENERAL REVISIONS | 03-17-2023 |
| 4 | AM. #0001 NEW DRAWING ADDED | 02-17-2023 |
| 3 | CHG. ORDER #0001 GENERAL REVISIONS | 02-09-2023 |

**A/E NAME AND LOCATION INFORMATION**

**ADDITIONAL PROJECT INFORMATION IF NEEDED**

**DRAWING TITLE**

* PROJECT CODE: FOR A/E DESIGN PROJECTS THIS DESIGNATION IS FOUND IN THE SCOPE CF WORK

* PROJECT CODE: FOR DESIGN BUILD PROJECTS THIS DESIGNATION IS FOUND IN THE R.F.P.

** FILE NUMBER: FOR A/E DESIGN PROJECTS THIS NUMBER IS FOUND IN THE SCOPE OF WORK

** FILE NUMBER: FOR DESIGN BUILD PROJECTS THIS NUMBER IS FOUND IN THE R.F.P.

**REVISION SYMBOL AND/OR NUMBER: SEE EXAMPLE ABOVE AND/OR AMENDMENT/MOD EXAMPLE DRAWING FOR CLARIFICATION**

**INDICATES REVISION TYPE AND DESCRIPTION: SEE EXAMPLE ABOVE AND/OR AMENDMENT/MOD EXAMPLE DRAWING FOR CLARIFICATION**

**DATE OF REVISION**

RECORD DRAWING

X
SHEET ID

PROJECT/CONTRACT LOCATION 1
PROJECT/CONTRACT DESCRIPTION 2
Y
Y
SHEET TITLE 1
SHEET TITLE 2
SHEET TITLE 3

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
1616 CAPITOL AVE.
OMAHA, NE 68102

X
X
X

| | |
|---|---|
| DESIGNED BY: J. DESIGNER | ISSUE DATE: MMMMMMMMM YYYY |
| DRAWN BY: J. DRAWER | SOLICITATION NO.: XXXXXX-XX-X-XXXX |
| CHECKED BY: J. CHECKER | CONTRACT NO.: XXXXXX-XX-X-XXXX |
| SUBMITTED BY: J. SUBMITTER | FILE NUMBER: |
| SIZE: ANSI D | FILE NAME: |

| MARK | DESCRIPTION | DATE |
|---|---|---|
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**SHEET 2 of 2**

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**05/19, CHG 2: 08/20**

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APPENDIX B - BASIS OF DESIGN

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-- End of Section Table of Contents --

SECTION 01 91 00.15 10

TOTAL BUILDING COMMISSIONING
**05/19, CHG 2: 08/20**

PART 1 GENERAL

1.1 SUMMARY

Commission the building systems listed herein. Employ the services of an independent Commissioning Firm. The Commissioning Firm must be a 1st tier subcontractor of the General or Prime Contractor and must be financially and corporately independent of all other subcontractors. The Commissioning Firm must employ a Lead Commissioning Specialist that coordinates all aspects of the commissioning process. Conform to the commissioning procedures outlined in this specification.

1.2 UNIFIED FACILTIES GUIDE SPECIFICATION REFERENCES

This specification section is intended to work in conjunction with the requirements included in the Unified Facilities Guide Specifications (UFGS) referenced within this specification section. Comply with the requirements of the referenced UFGS to the extent specified herein. UFGS can be found at on the Whole Building Design Guide website at: http://www.wbdg.org/

1.3 SYSTEMS TO BE COMMISSIONED

Commission the following systems:

Heating, Ventilating, Air Conditioning, and Refrigeration Systems (HVAC)
Building Automation System
Lighting Systems
Power Distribution Systems
Power Generation Systems
Service Water Heating Systems
Plumbing Systems
Natural Gas Systems

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 HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 180 | (2012) Standard Practice for Inspection and Maintenance of Commercial Building HVAC Systems |
| 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 |

## 1.5 COMMUNICATION WITH THE GOVERNMENT

The Lead Commissioning Specialist (CxC) must submit all plans, schedules, reports, and documentation directly to the Contracting Officer Representative concurrent with submission to the CQC System 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.

## 1.6 SEQUENCING AND SCHEDULING

### 1.6.1 Sequencing

Complete the following prior to starting Functional Performance Tests of mechanical systems:

a. All equipment and systems have been completed, cleaned, flushed, disinfected, calibrated, tested, and operate in accordance with contract documents and construction plans and specifications.

b. Performance Verification Tests of the controls systems have been completed and the Performance Verification Test Report has been submitted and approved in accordance with Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

c. Testing, Adjusting, and Balancing has been completed and the Testing, Adjusting, and Balancing Report, has been submitted and approved in accordance with Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

d. The building envelope is enclosed according to contract documents with final construction completed.

e. The Pre-Functional Checklists have been submitted and approved.

f. The Certificate of Readiness for mechanical systems has been submitted and approved.

Complete the following prior to starting Functional Performance Tests of the electrical systems:

a. All electrical, power generation, and lighting equipment and systems have been completed, calibrated, tested, and operate in accordance with contract documents and construction plans and specifications.

b. The building envelope is enclosed according to contract documents with final construction completed.

c. Ceiling tiles, floor coverings, and window coverings are in place.

d. The Certificate of Readiness for electrical systems has been submitted and approved.

e. Lamps have completed a minimum 100 hour burn-in period.

f. Furniture is in place.

1.6.2 Project Schedule

Include the following tasks in the project schedule required by Section 01 32 01.00 10 PROJECT SCHEDULE. Ensure sufficient time is scheduled to accommodate the requirements of this specification section. The order of items listed below is not intended to imply a specified sequence:

a. Submission and approval of the Commissioning Firm and Commissioning Specialist

b. Submission and approval of the Testing, Adjusting, and Balancing (TAB) Firm and TAB Specialist specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

c. Submission of the Design Review Report specified herein.

d. Submission of the Design Review Report specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

e. Submission and approval of the Construction Phase Commissioning Plan

f. Installation of permanent utilities (gas, water, electric)

g. Building Envelope Construction

h. Submission and approval of the Building Envelope Inspection Checklists

i. Drainage and Vent, Building Sewers, Water Supply Systems and Backflow Prevention Assembly Tests specified in Specification Section 22 00 00 PLUMBING, GENERAL PURPOSE

j. Factory Acceptance Testing for each of the systems to be commissioned as required by technical specifications

k. Manufacturer's Equipment Start-Up for each of the systems to be commissioned.

l. Potable Water System Flushing specified in Specification Section 22 00 00 PLUMBING, GENERAL PURPOSE

m. Operational Tests of the plumbing system specified in Specification Section 22 00 00 PLUMBING, GENERAL PURPOSE.

n. Potable Water System Disinfection specified in Specification Section 22 00 00 PLUMBING, GENERAL PURPOSE

o. Submission and approval of the TAB Schematic Drawings, Report Forms, and Procedures specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

p. Submission and approval of Duct Air Leakage Test Procedures specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

q. Duct Air Leakage Test Execution specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

r. Submission and approval of the Final Duct Air Leakage Test Report specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

s. Testing, Adjusting, and Balancing (TAB) Field Work required by Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

t. Submission and approval of the TAB Report specified in Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

u. TAB Field Acceptance Testing required by Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

v. Submission and approval of the Start-Up Testing Report specified in Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

w. Submission and approval of the Performance Verification Test Procedures specified in Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

x. Performance Verification Tests required by Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC

y. Performance Verification Test Report specified in Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC

z. Pre-Functional Checklist Submittal

aa. Functional Performance Testing for each system to be commissioned

bb. Integrated Systems Tests

cc. Post-Test Deficiency Correction for each system to be commissioned

dd. Re-Testing

ee. Training for each of the systems to be commissioned

ff. Systems Manual, Maintenance Plan, and Service Life Plan submission and approval

gg. Submission and approval of the Commissioning Report

hh. Post-Construction Endurance Testing

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-01 Preconstruction Submittals

Commissioning Firm

Lead Commissioning Specialist

Technical Commissioning Specialists

Commissioning Firm's Contract

SD-05 Design Data

Design Phase Commissioning Plan; G, DO

SD-06 Test Reports

Design Review Report

Interim Construction Phase Commissioning Plan

Final Construction Phase Commissioning Plan

Pre-Functional Checklists; G, DO

Issues Log

Commissioning Report; G, DO

Post-Construction Trend Log Report

SD-07 Certificates

Certificate of Readiness; G, DO

SD-10 Operation and Maintenance Data

Training Plan; G, RO

Training Attendance Rosters

Maintenance and Service Life Plans; G, DO

SD-11 Closeout Submittals

Final Commissioning Report; G,RO

Final Construction Phase Commissioning Plan; G, RO

## 1.8 COMMISSIONING FIRM

Provide a Commissioning Firm that is certified in commissioning by one of the following: the AABC Commissioning Group (ACG); the National Environmental Balancing Bureau (NEBB); the International Certification Board/Testing, Adjusting, and Balancing Bureau (ICB/TABB), the Building Commissioning Association (BCA); the Association of Energy Engineers (AEE). The Commissioning Firm may employ a commissioning professional certified by the University of Wisconsin-Madison or the American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) as required in paragraph LEAD COMMISSIONING SPECIALIST as an alternative to certification of the Commissioning Firm. The Commissioning Firm must be certified in all systems to be commissioned to the extent such certifications are available from the certifying body. Describe any lapses in certification or disciplinary action taken by the certifying body against the proposed Commissioning Firm or Lead Commissioning Specialist in detail. Any firm or commissioning professional that has been the subject of disciplinary action by the certifying body within the five years preceding contract award is not eligible to perform any duties related to commissioning.

a. Submit the Commissioning Firm's certification of qualifications including the name of the firm and certifications no later than 30 calendar days after Notice to Proceed. Submit one hard copy and an electronic copy.

b. The Commissioning Firm's and Commissioning Specialists' certifications must be maintained for the entire duration of the duties specified herein. If, for any reason, the firm or a specialist loses a certification during this period, immediately notify the Contracting Officer's Representative and submit another Commissioning Firm or Commissioning Specialist for approval. All work specified in this specification section performed by the Commissioning Firm or associated Commissioning Specialists is invalid if the Commissioning Firm or Commissioning Specialist loses its certification prior to contract completion and must be performed by an approved successor.

c. The Commissioning Firm must oversee and assist the General or Prime Contractor with the work specified herein. Submit the Commissioning Firm's Contract including the Scope of Work associated with the paragraph POST-CONSTRUCTION SUPPORT no later than 30 calendar days after approval of the Commissioning Firm. Submit one hard copy and an electronic copy.

### 1.8.1 Lead Commissioning Specialist

The Commissioning Firm must provide a Lead Commissioning Specialist (CxC) that has a minimum of five years of commissioning experience, including two projects of similar size and complexity, and that is one of the following: a 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); Building Commissioning Professional (BCxP).

a. Submit the Lead Commissioning Specialist's certification of qualifications including the name of the specialist and firm; certifications; years of experience; and a listing of representative projects of similar size and complexity no later than 30 calendar days

after Notice to Proceed. Submit one hard copy and an electronic copy.

b. The Lead Commissioning Specialists certifications must be maintained for the entire duration of the duties specified herein. If, for any reason, the specialist loses a certification during this period, immediately notify the Contracting Officer's Representative and submit another Lead Commissioning Specialist for approval. All work specified in this specification section to be performed by the Lead Commissioning Specialist is invalid if the Lead Commissioning Specialist loses its certification prior to contract completion and must be performed by an approved successor.

c. The Lead Commissioning Specialist must lead and oversee the commissioning work specified herein and be the primary point of contact for the Government regarding the commissioning work. One of the Technical Commissioning Specialists may be the Lead Commissioning Specialist provided that all of the qualification requirements are met.

1.8.2 Technical Commissioning Specialists

Technical Commissioning Specialists, employed by the Commissioning Firm and that have the following qualifications, must perform the technical work specified herein associated with each system to be commissioned:

a. Mechanical Technical Commissioning Specialist: The technical work associated with mechanical systems including Heating, Ventilating, Air Conditioning, and Refrigeration Systems; Building Automation System; Service Water Heating Systems; Plumbing Systems must be performed by a Commissioning Specialist certified by NEBB, ACG, ICB/TABB, or BCA in the commissioning of HVAC systems with five years of experience in the commissioning of HVAC systems.

b. Electrical Technical Commissioning Specialist: The technical work associated with electrical systems including Lighting Systems; Power Distribution Systems; Power Generation Systems; must be performed by an engineering technician certified by the InterNational Electrical Testing Association (NETA) with five years of experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

c. Submit the Technical Commissioning Specialist's certification of qualifications including the name of the specialist and firm; certifications; years of experience; and a listing of representative projects of similar size and complexity no later than 30 calendar days after Notice to Proceed. Submit one hard copy and an electronic copy.

1.8.3 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 the acceptable standards unless otherwise stated herein. The acceptable standards are 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 prior to contract solicitation by the body responsible for the Commissioning Standard.

1.9 ISSUES LOG

The Lead Commissioning Specialist must develop and maintain an Issues Log for tracking and resolution of all deficiencies discovered through submittal reviews, inspection, and testing. Include the date of final resolution of issues as confirmed by the Commissioning Specialist. Submit the Issues Log on a monthly basis at a minimum. 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.

Track construction deficiencies identified in the Issues Log using QCS as specified in Specification Section 01 45 00.15 10 RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE(RMS CM).

1.10 CERTIFICATE OF READINESS

Prior to scheduling Functional Performance Tests for each system, issue a Certificate of Readiness for the system certifying that the system is ready for Functional Performance Testing. The Certificate of Readiness must include, for each system to be commissioned, all equipment and system start-up reports; Performance Verification Test Reports; completed Building Envelope Inspection Checklists; completed Pre-Functional Checklists; Testing, Adjusting, and Balancing (TAB) Report; HVAC Controls Start-Up Reports; and the Air Leakage Test Reports and Diagnostic Test Reports to the extent applicable to the system. The Contractor; the Lead Commissioning Specialist; the Contractor's Quality Control Representative; the Mechanical, Electrical, Controls, and TAB subcontractor representatives must sign and date the Certificate of Readiness. Submit the Certificate of Readiness for each system no later than 14 calendar days prior to Functional Performance Tests of that system. Submit one hard copy and an electronic copy. Do not schedule Functional Performance Tests for a system until the Certificate of Readiness for that system receives approval by the Government.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 DESIGN PHASE

3.1.1 Design Commissioning Coordination Meeting

The Lead Commissioning Specialist (CxC) must lead a meeting prior to the interim design submittal for any system required to be commissioned to discuss the commissioning process including project contract requirements, lines of communication, roles and responsibilities, schedules, and documentation requirements. The Contractor's Superintendent or Project Manager, the Contractor's Quality Control Representative, the Designers of Record for the commissioned systems, and the Government must attend this meeting. The User and a Reserve Support Command Representative a Base Civil Engineer Office Representative, may attend this meeting.

3.1.2 Design Phase Commissioning Plan

The Lead Commissioning Specialist (CxC) must prepare the Design Phase Commissioning Plan. Submit the Design Phase Commissioning Plan no later than 14 calendar days after approval of the Commissioning Specialists. Submit one hard copy and an electronic copy.

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.

3.1.3 Design Review

The Lead Commissioning Specialist and Technical Commissioning Specialists must review the design-build construction contract, Design Plans and Specifications, the Basis of Design, and the Owner's Project Requirements Document prior to 60 percent completion of the design. The Owner's Project Requirements Document is attached as Appendix A. The Owner's Project Requirements Document is not contract requirements and is provided for commissioning review purposes only. The Commissioning Specialists must assess the completeness and clarity of the Owner's Project Requirements, verify that the requirements stated in the design-build construction contract and the Owner's Project Requirements are addressed in the Basis of Design, and verify that the Design Plans and Specifications are prepared in accordance with the Basis of Design, the design-build construction contract, the Unified Facilities Criteria (UFC) referenced by the design-build construction contract, and the Owner's Project Requirements. The Commissioning Specialists must also identify any deficiencies that would prevent the building systems from operating or performing effectively. The Commissioning Specialists must backcheck the reviewed documents at all subsequent design documentation submissions.

The Commissioning Specialists must provide a Design Review Report for each submittal identifying any discrepancies between the reviewed documents or deficiencies that would prevent the building systems and features from operating or performing effectively in accordance with the design-build construction contract and Owner's Project Requirements Document and from being adequately maintainable. Individually list each deficiency and the corresponding proposed corrective action necessary for proper system performance in the Design Review Report. Submit one hard copy and an electronic copy of the report with the corrected final design submission.

The Contracting Officer's Representative, the Lead Commissioning Specialist, 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.

## 3.2 CONSTRUCTION PHASE

### 3.2.1 Construction Commissioning Coordination Meeting

The Lead Commissioning Specialist must lead a Construction Commissioning Coordination Meeting no later than 14 days after approval of the Commissioning Firm and Commissioning Specialists30 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 specification section. The Contractor's Superintendent or Project Manager, the Contractor's Quality Control Representative, and the Government must attend this meeting. Invite the User and a Reserve Support Command Representative a Base Civil Engineer Office Representative, to attend this meeting.

### 3.2.2 Construction Phase Commissioning Plan

#### 3.2.2.1 Interim Construction Phase Commissioning Plan

The Lead Commissioning Specialist (CxC) must prepare the Interim Construction Phase Commissioning Plan. Submit the Interim Construction Phase Commissioning Plan no later than 30 calendar days after the Construction Commissioning Coordination Meeting and no later than 14 days prior to the start of construction of the building envelope. Submit one hard copy and an electronic copy.

Identify 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, and Template Building Envelope Inspection Checklists in the Interim Construction Phase Commissioning Plan.

##### 3.2.2.1.1 Checklists

Download example Pre-Functional Checklists, Integrated Systems Test Checklists, and Functional Performance Test Checklists for specification section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING at the following location:
http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic
The checklists submitted in the Interim and Final Construction Phase Commissioning Plans must contain the same level of detail shown in the examples. The submitted checklists are not required to match the format of the examples.

#### 3.2.2.2 Final Construction Phase Commissioning Plan

The Lead Commissioning Specialist (CxC) must prepare the Final Construction Phase Commissioning Plan. Submit the Final Construction Phase Commissioning Plan no later than 30 calendar days prior to the start of Pre-Functional Checks. Submit one hard copy and an electronic copy. Once approved, file the approved plan in the Sustainability eNotebook.

Include the information provided in the Interim Construction Phase Commissioning Plan. In addition, the Technical Commissioning Specialist must develop the Pre-Functional Checklists, Integrated Systems Test 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.

3.2.2.2.1 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 for more information.

3.2.2.2.2 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 for more information. 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.

3.2.2.2.3 Integrated Systems Test Checklists

Integrated Systems Test Checklists must include test procedures that

explain, step-by-step, the actions and expected results that will demonstrate that the interactive operations between systems performs in accordance with the contract. Refer to paragraph Functional Performance and Integrated Systems Tests for more information. Include the following sections in the Integrated Systems Test Checklists:

a. Notable features of the interconnected systems organized by discipline including information to facilitate understanding of system operation

b. Conclusions and recommendations. Conclusions must clearly indicate if the systems do or do not perform in accordance with contract requirements. Recommendation must clearly indicate that the systems should or should not be accepted by the Government

c. Test conditions including date and beginning and ending time

d. Attendees

e. Identification of the equipment and systems involved in the test

f. 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.

g. Space for comments for each test item.

3.2.3 Design Review

The Lead Commissioning Specialist and Technical Commissioning Specialists must review the construction contract plans and specifications, the Owner's Project Requirements Document, and the Basis of Design. The Owner's Project Requirements Document is attached as Appendix A. The Basis of Design is attached as Appendix B. The Owner's Project Requirements Document and Basis of Design documents are not contract documents and are provided for commissioning review purposes only.

a. Advise the Contracting Officer's Representative of any discrepancies between the Basis of Design and Owner's Project Requirements, deficiencies of the design to comply with the Owner's Project Requirements or Basis of Design, and deficiencies that would prevent the building systems and features from operating or performing effectively and from being adequately maintainable.

b. The Commissioning Specialists must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation or performance. Submit one hard copy and an electronic copy of the report to the Contracting Officer's Representative no later than 14 days after approval of the Commissioning Specialists.

c. The Lead Commissioning Specialist must participate in a meeting to discuss any items contained in the report no later than 14 calendar days after submission of the report.

3.2.4 Construction Submittals

Provide all submittals associated with the systems to be commissioned, including shop drawings; equipment submittals; test plans, procedures, and reports; and resubmittal's to the Commissioning Specialists. The

Technical Commissioning Specialist must review the submittals to the extent necessary verify that the equipment and system installation will comply with the contract requirements, the Unified Facilities Criteria (UFC) referenced by the design-build contract, and the requirements of the Basis of Design and the Owner's Project Requirements Document.

3.2.5 Inspection and Testing

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 Owner's Project Requirements. Requirements in related specification sections are independent from the requirements of this section and do not satisfy any of the requirements specified in this specification section. Provide all materials, services, and labor required to perform the Pre-Functional Checks, Building Envelope Inspection, Integrated Systems Tests, and Functional Performance Tests.

3.2.5.1 Commissioning Team

Provide a commissioning representative for each sub-contractor associated with the systems to be commissioned. Each commissioning representative is responsible for coordination of their respective sub-contractor's execution of the commissioning activities and participation in the inspection and testing required by this specification section. The designers listed below are the designers of record for their respective systems. Substitutes must be approved by the Contracting Officer's Representative.

3.2.5.1.1 Mechanical System Pre-Functional Checks Team

The following team members must participate in Pre-Functional checks of mechanical systems:

| Designation | Function |
|---|---|
| CxM | Mechanical System Technical Commissioning Specialist |
| QAR | Contracting Officer's Quality Assurance Representative |
| CQC | Contractor's Quality Control Personnel |
| MC | Contractor's Mechanical Commissioning Representative |
| EC | Contractor's Electrical Commissioning Representative |
| CC | Contractor's Controls Commissioning Representative |
| TABC | Contractor's TAB Commissioning Representative |
| PC | Contractor's Plumbing Commissioning Representative |
| IC | Contractor's Irrigation Commissioning Representative |

3.2.5.1.2 Electrical System Pre-Functional Checks Team

The following team members must participate in Pre-Functional checks of electrical systems:

| Designation | Function |
|---|---|
| CxE | Electrical System Technical Commissioning Specialist |
| QAR | Contracting Officer's Quality Assurance Representative |
| CQC | Contractor's Quality Control Personnel |
| EC | Contractor's Electrical Commissioning Representative |

3.2.5.1.3 Mechanical Systems Test Team

The following team members must participate in Functional Performance, and Integrated Systems Testing of mechanical systems:

| Designation | Function |
|---|---|
| CxM | Mechanical System Technical Commissioning Specialist |
| QAR | Contracting Officer's Quality Assurance Representative |
| CQC | Contractor's Quality Control Personnel |
| MC | Contractor's Mechanical Commissioning Representative |
| EC | Contractor's Electrical Commissioning Representative |
| CC | Contractor's Controls Commissioning Representative |
| TABC | Contractor's TAB Commissioning Representative |
| PC | Contractor's Plumbing Commissioning Representative |
| IC | Contractor's Irrigation Commissioning Representative |
| MD | Mechanical Designer |
| PD | Plumbing Designer |

3.2.5.1.4 Electrical Systems Test Team

The following team members must participate in Functional Performance and Integrated Systems Testing of electrical systems:

| Designation | Function |
|---|---|
| CxE | Electrical System Technical Commissioning Specialist |

| Designation | Function |
|---|---|
| QAR | Contracting Officer's Quality Assurance Representative |
| CQC | Contractor's Quality Control Personnel |
| EC | Contractor's Electrical Commissioning Representative |

3.2.5.1.5 Other Pre-Functional and Functional Performance Participants

The following may participate as team members during Pre-Functional Checks and Functional Performance Testing:

| Designation | Function |
|---|---|
| DPW | Directorate of Public Works Representative |
| BCE | Base Civil Engineer Office Representative |
| RSC | Reserve Support Command Representative |
| User | Using Agent's Representative |

3.2.5.2 Pre-Functional Checks

Pre-Functional Checklists from the approved Final Construction Phase Commissioning Plan must be completed by the commissioning team. 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 construction contract and accepted design requirements in their area of responsibility. Technical 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. Submit the completed and initialed Pre-Functional Checklists no later than 7 calendar days after completion of inspection of all checklists items for each system. Submit one hard copy and an electronic copy. Include manufacturer start-up checklists associated with equipment with the submission of the Pre-Functional Checklists.

3.2.5.3 Testing, Adjusting, and Balancing (TAB) Report and Field Acceptance Testing

The Mechanical System Technical Commissioning Specialist must review the pre-final TAB Report required by Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Identify any deficiencies to the Contracting Officer's Representative and the Contractor's Quality Control Personnel. Resolve all deficiencies prior to TAB Field Acceptance Testing.

The Mechanical System Technical Commissioning Specialist must witness the

TAB Field Acceptance Testing specified by Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Include a certification by the Mechanical Technical Specialist that no outstanding deficiencies exist in the systems relative to Testing, Adjusting, and Balancing with the final TAB Report submittal.

3.2.5.4 HVAC Controls Test Reports

The Mechanical System Technical Commissioning Specialist must review the Start-Up Testing Report and the PVT Procedures and Reports required by Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. Include a certification by the Mechanical System Technical Commissioning Specialist that the submittals contain no deficiencies or that the submittals do not indicate any deficiencies in the HVAC systems or HVAC control systems with each of these submittals.

3.2.5.5 Tests

3.2.5.5.1 Functional Performance and Integrated Systems Tests

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. Perform Integrated Systems Tests only after the Functional Performance Tests for each associated system are completed with all deficiencies resolved and after the related Functional Performance Test Checklists have been signed by each commissioning team member.

a. Functional Performance Tests and Integrated Systems Tests must be performed with the Contracting Officer's Quality Assurance Representative present.

b. Abort Functional Performance Tests or Integrated Systems Tests when any system deficiency prevents the successful completion of the test.

c. Technical Commissioning Specialists must lead and document all Functional Performance Tests and Integrated Systems Tests for the systems to be commissioned with the Contractor and appropriate sub-contractors performing the Functional Performance Tests and Integrated Systems Tests. The representatives listed in the paragraph Commissioning Team must attend the tests. Abort Functional Performance Tests or Integrated Systems Tests when any required commissioning team member is not present for the test.

3.2.5.5.1.1 Checklist

Use the Functional Performance Test and Integrated Systems Test Checklists from the approved Final Construction Phase Commissioning Plan to guide the Functional Performance Tests and Integrated Systems Tests. Functional Performance Tests must be performed for each item of equipment and each system required to be commissioned and verify all sensor calibrations, control responses, safeties, interlocks, operating modes, sequences of operation, capacities, lighting levels, and all other performance requirements comply with construction contract and accepted design requirements regardless of the specific items listed within the Functional Performance Test and Integrated Systems Test Checklists provided. Testing must progress from equipment or components to subsystems to systems to interlocks and connections between systems. Integrated Systems Tests must

be performed for the interactive operation between systems such as HVAC systems, fire protection systems, back-up electrical supply, energy generation systems, and other systems, and verify correct interactive operation, acceptable speed of response, and other contract requirements for both normal and failure modes. Examples of Integrated Systems Tests include the correct operation of HVAC systems during emergency system activation, correct operation of uninterruptible power supplies or energy generators and connected systems, or lighting system operation during power outage or emergency system activation. The order of components and systems to be tested must be determined by the Technical Commissioning Specialists.

3.2.5.5.1.2 Acceptance

Indicate acceptance of each item of equipment and systems tested by signature of each commissioning team member for each Functional Performance Test or Integrated Systems Test Checklist. The Contractor's Quality Control Representative and the Technical Commissioning Specialists must indicate acceptance after the equipment and systems are free of deficiencies.

3.2.5.5.2 HVAC Test Methods

Perform Functional Performance Tests in accordance with the following:

3.2.5.5.2.1 Prior to Testing

Prior to testing operating modes, sequences of operation, interlocks, and safeties, complete control point-to-point observations, test sensor calibrations, and test actuator commands.

3.2.5.5.2.2 Simulating Conditions

Over-writing control input values through the controls system is not acceptable, unless approved by the Contracting Officer's Representative. Identify proposed exceptions in a protocol submitted to the Contracting Officer's Representative for approval. Before simulating conditions, overwriting values (if approved), or changing set-points, calibrate all sensors, transducers and devices. Below are several examples of exceptions that would be considered acceptable:

a. When varying static pressures inside ductwork can not be simulated within the duct, and where a sensor signals the controls system to initiate sequences at various duct static pressures, it is acceptable to simulate the various pressures with a Pneumatic Squeeze-Bulb Type Signaling Device with gauge temporarily attached to the sensing tube leading to the transmitter. It is not acceptable to reset the various set-points, nor to simulate an electric analog signal (unless approved as noted above).

b. Dirty filter pressure drops can be simulated using sheets of cardboard at filter face.

c. Freeze-stat safeties can be simulated by packing portion of sensor with ice.

d. High outside air temperatures can be simulated with a hair blower.

e. High entering cooling coil temperatures can be used to simulate

entering cooling coil conditions.

f. Do not use signal generators to simulate sensor signals unless approved by the Contracting Officer's Representative, as noted above, for special cases.

g. Control set points can be altered. For example, to see the air conditioning compressor lockout work at an outside air temperature below 55 degrees F, when the outside air temperature is above 55 degrees F, temporarily change the lockout set point to be 0 degrees F above the current outside air temperature. Caution: Set points are not to be raised or lowered to a point such that damage to the components, systems, or the building structure and/or contents will occur.

h. Test duct mounted smoke detectors in accordance with the manufacturer's recommendations. Perform the tests with air system at minimum airflow condition in ductwork.

i. Test current sensing relays used for fan and pump status signals to control system to indicate unit failure and run status by resetting the set point on the relay to simulate a lost belt or unit failure while the unit is running. Confirm that the failure alarm was generated and received at the control system. After the test is conducted, return the set point to its original set-point or a set-point as indicated by the Contracting Officer's Representative.

3.2.5.5.2.3 Setup

Perform each test under conditions that simulate actual conditions as close as is practically possible. Provide all necessary materials and system modifications to produce the necessary flows, pressures, temperatures, and other conditions necessary to execute the test according to the specified conditions. At completion of the test, return the affected building equipment and systems to their pre-test condition.

3.2.5.5.3 Sample Strategy

Perform Functional Performance Tests using the following sample strategy. Prepare and complete a Functional Performance Test Checklist for each item of equipment or system to be tested. For sample sizes less than 100 percent for all similar equipment, the Government will select the specific equipment or system to be tested during testing. Equipment Identifiers are as indicated on the design drawings:

| Equipment Identifier | Sample Size (Percent) |
|---|---|
| AHU | 100 |
| VAV | 100 |
| EF | 100 |
| HWP | 100 |
| FCU/CU | 100 |

| Equipment Identifier | Sample Size (Percent) |
|---|---|
| Lighting Controls | 100 |

Perform Integrated Systems Tests for all systems and equipment having interactive operation.

Perform Functional Performance Tests and Integrated Systems Tests for all equipment and systems. Prepare and complete a Functional Performance Test Checklist for each item of equipment or system. Prepare and complete an Integrated Systems Test Checklist for each item of equipment or system.

3.2.5.5.4 Aborted Tests and Re-Testing

Abort Functional Performance Tests, Integrated Systems Tests, or Seasonal Tests if any deficiency prevents successful completion of the test or if any required commissioning team member is not present for the test. Reimburse the Government for all costs associated with effort lost due to re-testing due to test failures and aborted tests. These costs must include salary, travel costs, and per diem for Government commissioning team members. Re-test only after all deficiencies identified during the original tests have been corrected.

3.2.5.5.4.1 100 Percent Sample

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.

3.2.5.5.4.2 Less than 100 Percent Sample

For systems tests with a sample size less than 100 percent, if one or more of the test procedures for an item of equipment or a system results in discovery of a deficiency, regardless of whether the deficiency is corrected during the sample tests, the item of equipment or system fails the test.

a. If the system failure rate is 5 percent or less, meaning that 5 percent or less of the equipment or systems had at least one deficiency, re-test only on the items which experienced the initial failures.

b. If the system failure rate is higher than 5 percent, meaning that more than 5 percent of equipment or systems tested had at least one deficiency, re-test the items which experienced the initial failures to the extent necessary to confirm that the deficiencies have been corrected . In addition, test another random sample of the same size as the initial sample for the first time. If the second random sample set has any failures, re-test those failed items and all remaining equipment and systems to complete 100 percent testing of that system type.

3.2.6 Training Plan

Develop a training plan which identifies all training required by specification sections associated with commissioned systems. Include a matrix listing each training requirement, content of the training, the trainer name, trainer contact information, and schedule and location of training. Submit one hard copy and an electronic copy of the Training Plan to the Commissioning Specialists and the Government no later than 30 calendar days prior to the associated training.

Document training attendance using training attendance rosters and provide completed attendance rosters to the Commissioning Specialists and the Government no later than 7 calendar days following the completion of training for each system to be commissioned. Submit one hard copy and an electronic copy.

3.2.7 Systems Manual

Prepare and submit a Systems Manual including a signed certification or letter from the Technical Commissioning Specalists and the Lead Commissioning Specialist 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/. Update and resubmit the Systems Manual based on any corrective action taken during the warranty period.

Submit Systems Manual no later than 30 calendar days following completion of Functional Performance Tests and Integrated Systems Tests. Submit three hard copies and an electronic copy.

3.2.8 Maintenance and Service Life Plans

3.2.8.1 Maintenance Plan

Prepare and submit a Maintenance Plan for the project mechanical, electrical, plumbing, and fire protection systems. Prepare the HVAC and refrigeration sections of the Maintenance Plan in accordance with ASHRAE 180. Develop required inspection and maintenance tasks similar to Section 5 of ASHRAE 180 for the other commissioned systems and fire protection systems.

Submit the Maintenance Plan no later than 30 calendar days following the completion of Functional Performance Tests and Integrated Systems Tests. Submit three hard copies and an electronic copy.

3.2.8.2 Service Life Plan

Prepare and submit a Service Life Plan for the building envelope, structural systems, and site hardscape that includes the following for each assembly or component:

a. A description of each including the materials or products.

b. The estimated service life, in years.

c. The estimated maintenance frequency and description of maintenance

tasks.

d. The point of maintenance access for the components with estimated service life less than service life of the building.

Submit the Service Life Plan no later than 30 calendar days following the completion of Functional Performance Tests and Integrated Systems Tests. Submit three hard copies and an electronic copy.

## 3.3 COMMISSIONING REPORT

Following the completion of Functional Performance Tests and Integrated Systems Tests, with the exception of Seasonal Tests, the Lead Commissioning Specialist must prepare a Commissioning Report.

a. Include an executive summary describing the overall commissioning process, the results of the commissioning process, any outstanding deficiencies and recommended resolutions, and any seasonal testing that must be scheduled for a later date. Indicate, in the executive summary, whether the systems meet the requirements of the construction contract and accepted design and the Owner's Project Requirements.

b. Detail any deficiencies discovered during the commissioning process and the corrective actions taken in the report. Include the completed Pre-Functional Checklists, Functional Performance Test Checklists, Integrated Systems Test Checklists,the Commissioning Plans, the Issues Log, Performance Verification Test Reports, Training Attendance Rosters, the Design Review Report, the final TAB Report.

c. Submit the Commissioning Report no later than 14 calendar days following commissioning team acceptance of all Functional Performance Tests and Integrated Systems Tests with the exception of Seasonal Tests. Submit three hard copies and an electronic copy.

d. Following any Seasonal Tests or Post-Construction Activities, update the Final Commissioning Report to reflect any changes and resubmit. File the approved, updated, Final Commissioning Report in the Sustainability eNotebook.

## 3.4 POST-CONSTRUCTION SUPPORT

### 3.4.1 Post-Construction Endurance Test

Perform an Endurance Test in accordance with the paragraph Endurance Test in Specification Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC once during the peak heating season and once during the peak cooling season during outdoor air condition extremes with the exception that network bandwidth usage measurement and recording is not required.

The Mechanical System Commissioning Specialists must review the trend logs from the Endurance Tests to ensure that the systems have stable operation and operate as required by the construction contract, the accepted design, and the Owner's Project Requirements Document. The Commissioning Specialists must provide a Post-Construction Trend Log Report that identifies any deficiencies noted in operation, recommendations for correction, and includes a graphical representation of the trends. Provide one Trend Log Report for the peak cooling season and one Trend Log Report for the peak heating season. Submit one hard copy and one electronic copy of the Post-Construction Trend Log Reports no later than

14 calendar days following receipt of the trend log data by the Commissioning Specialist.

**APPENDIX A - OWNER'S PROJECT REQUIREMENTS DOCUMENT**

**OWNER'S PROJECT REQUIREMENTS DOCUMENT**

Project: Project, Location, PN #####

Approved:

| | | |
|---|---|---|
| Name | Design Agent's Representative | Date |
| Name | Owner's Representative | Date |

**OWNER'S PROJECT REQUIREMENTS DOCUMENT**

Contents

1. Owner and User Requirements
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6. Building Occupant and O&M Personnel Requirements
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c. Occupant Training and Orientation
d. O&M Staff Training and Orientation

1. Owner and User Requirements

a. Primary Purpose, Program, and Use

Explain the purpose, program, and use of the facility. (i.e. Army Reserve Center used for training reserve units. Training includes spaces such as weapons, medical, vehicle repair, cooking, etc.)

b. Project History

Explain the history of the project related to design/construction (i.e. D/B/B, D/B, IDIQ, JOC, COE in-house, A/E, etc.). Explain any additional project background that would impact energy/sustainability goals.

c. Broad Goals

i. Future Expansion: Explain goals related to potential future expansion.

ii. Flexibility: Explain goals related to flexibility for layout and use of the building. (i.e. high rate of office churn, expected frequency of renovation, etc.)

iii. Quality of Materials: Explain goals related to quality of materials. (i.e. highest quality materials, 50 yr life, 25 yr life, highest quality within budget, etc.)

iv. Construction Costs: Explain goals related to construction costs. (i.e. how low can you go, set project amount, select simplest systems for low cost, etc.)

v. Operational Costs: Explain goals related to operational costs. (i.e. low utilities based on water and energy conservation, trade-off allowable on maintenance costs to reduce utility cost, utility cost unimportant compared to construction cost, etc.)

2. Environmental and Sustainability Goals

a. Other

Explain any special sustainability or environmental goals associated with the project. Identify specific sustainability features that may be required or desired. (i.e. hydro-power, solar power, on-site water treatment, on-site water infiltration, impervious cover reduction, parking capacity, etc.)

3. Energy Efficiency Goals

a. Goals/Policy

Explain the specific project goals and requirements regarding energy efficiency. Incorporate the requirements of UFC 1-200-02 High Performance and Sustainable Building Requirements and/or other relevant agency policies.

b. Systems and Feature Energy Impacts

Identify and explain envelope, system, or site and building features that will be incorporated to maximize energy efficiency. Identify features that must be incorporated that will reduce or limit energy efficiency.

4. Indoor Environmental Quality Requirements

a. Space Type 1

i. Intended Use: Explain how the space will be used (i.e. classroom occasionally used as conference room).

ii. Occupancy Schedule: Describe the occupancy including number of people at various times (i.e. drill weekend-maximum capacity, weekdays-20 percent; or 0700-0900 - none, 0900-1400 - 30 people, 1400-1600 - none).

iii. Environmental Requirements: Describe the environmental requirements of the space. Include description of temperatures, humidity levels, ventilation rates, air quality, lighting levels, or any other specific parameters desired (i.e. 75 deg F, 50 percent rh, 30 fc, etc.).

iv. Occupant System Control Ability: Describe the desired level of control the occupants will have over the thermal comfort and lighting systems. (i.e. adjustable thermostat for every person, adjustable thermostat in all private offices, no adjustable thermostats, adjustable thermostat in senior rank also controlling other offices, occupancy sensors for lighting, adjustable dimming, etc.)

v. Type of Lighting: Describe the type of lighting desired (i.e. task lighting with minimal overhead, maximize daylight with dimming on overhead, accent lighting, particular fixtures, etc.).

vi. After-hour Use Accommodations: Describe whether and how often the space may be used after hours. Describe the systems that activate when an occupant uses the building after-hours. Describe the level of control of after-hour use HVAC.

(Example: Space is rarely used after-hours by few occupants. HVAC and lighting system should activate when occupants enter after-hours. The HVAC operation will be limited to that required to provide heating, A/C, and ventilation to the occupied space alone.) (Example: Space is rarely used after-hours by few occupants. Lighting and heating systems should activate. Ventilation and cooling should remain in normal after-hour operation.)

b. Space Type 2

5. Equipment and System Expectations

a. HVAC Systems

i. Quality and Reliability: Explain the level of quality and reliability required of the HVAC systems.

(Example: Equipment efficiency should meet ASHRAE and FEMP/Energy Star requirements. Due to critical nature of facility, additional redundancy in the cooling and heating systems is required, i.e. multiple chillers, boilers, and pumps.) (Example: No specific quality or reliability requirements specified. Equipment should remain serviceable over life of building or to the extent typical of the type of equipment.)

ii. Type: Explain the type of equipment desired.

(Example: Boilers should be condensing type. Use hydronic heating and cooling. Use self-contained A/C units in computer rooms.)

iii. Automation: Explain the level of automation in the HVAC System desired.

(Example: Single loop HVAC systems permissible. Use packaged controls only.) (Example: Control HVAC systems from DDC system connected to the base UMCS.) (Example: Boilers should have packaged controls connected to the DDC system.)

iv. Flexibility: Describe the desired level of flexibility of the HVAC system.

(Example: System should accommodate frequent office layout changes including private office wall movement.) (Example: Layout will remain mostly unchanged; no flexibility required.) (Example: Accommodate potential for conference and classrooms to change to offices.)

v. Maintenance Requirements: Describe the level of maintenance available or the requirements of the equipment regarding maintainability.

(Example: Equipment should be located to allow easy maintenance access. Equipment vendors or repair service should be able to respond within 24 hrs.)

b. Lighting Systems

i. Quality and Reliability: Explain the level of quality and reliability required of the lighting system controls.

(Example: The building lighting system should meet ASHRAE 90.1 - IP requirements.)

ii. Type: Explain the type of lighting or control equipment desired.

(Example: High-efficiency fluorescent lamps with high-efficiency ballasts will be specified. Indirect lighting will be used in all office and classroom spaces. Lighting foot-candle levels may be reduced to 45 foot-candles in lieu of the typical 50 foot-candles when indirect lighting is used.)

iii. Automation: Explain the level of automation in the lighting control

system desired.

(Example: Provide occupancy sensors in restrooms, corridors, and storage areas.)

iv. Flexibility: Describe the desired level of flexibility of the lighting system and control systems.

(Example: Provide dual level switching in classrooms and conference rooms.)

v. Maintenance Requirements: Describe the level of maintenance available or the requirements of the equipment regarding maintainability.

(Example: )

c. Domestic Hot Water Systems

i. Quality and Reliability: Explain the level of quality and reliability required of the domestic hot water systems.

(Example: Equipment efficiency should meet ASHRAE and FEMP/Energy Star requirements. Due to critical nature of facility, additional redundancy in the water heating systems is required, i.e. multiple hot water heaters and circulation pumps.) (Example: No specific quality or reliability requirements specified. Equipment should remain serviceable over life of building or to the extent typical of the type of equipment.)

ii. Type: Explain the type of equipment desired.

(Example: Gas-fired storage tank water heater with mixing valve for temperature control.) (Example: Instantaneous electric water heater at lavatories.) (Example: Instantaneous electric water heater with integral control system for eyewash/showers.)

iii. Automation: Explain the level of automation in the domestic hot water control system desired.

(Example: Occupancy schedule control for recirculation loop and gas burner. Connect package controls to DDC system.)

iv. Flexibility: Describe the desired level of flexibility of the domestic hot water systems.

(Example: No anticipated changes to restroom layout; no additional flexibility required.)

v. Maintenance Requirements: Describe the level of maintenance available or the requirements of the equipment regarding maintainability.

(Example: Equipment should be located to allow easy maintenance access. Equipment vendors or repair service should be able to respond within 24 hrs.)

d. On-site Power Systems

i. Quality and Reliability: Explain the level of quality and reliability required of the on-site power system.

ii. Type: Explain the type of on-site power system desired.

iii. Automation: Explain the level of automation in the on-site power system desired.

iv. Flexibility: Describe the desired level of flexibility of the on-site power system.

v. Maintenance Requirements: Describe the level of maintenance available or the requirements of the on-site power system regarding maintainability.

e. Other Systems

i. Quality and Reliability: Explain the level of quality and reliability required of the system.

ii. Type: Explain the type of system desired.

iii. Automation: Explain the level of automation in the system desired.

iv. Flexibility: Describe the desired level of flexibility of the system.

v. Maintenance Requirements: Describe the level of maintenance available or the requirements of the system regarding maintainability.

6. Building Occupant and O&M Personnel Requirements

a. Facility Operation

Describe how the facility will be operated. Who operates the facility? Who maintains the facility? Who pays the utility bills?

b. UMCS (EMCS or FMCS)

Will the building be tied to an UMCS/EMCS/FMCS? What system will be connected to? Provide information regarding connection requirements, protocols, and control, scheduling and monitoring points.

c. Occupant Training and Orientation

How much training and orientation is desired for building occupants? Will training need to be provided for all systems? To what extent do the occupants need to understand and use the systems?

d. O&M Staff Training and Orientation

How much training and orientation is desired for building occupants? Will training need to be provided for all systems? To what extent do the occupants need to understand and use the systems?

# APPENDIX B - BASIS OF DESIGN

**APPENDIX C - DESIGN PHASE COMMISSIONING PLAN**

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DEMOLITION
**08/22**

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 SOCIETY OF SAFETY PROFESSIONALS (ASSP)

| | |
|---|---|
| ASSP A10.6 | (2006) Safety & Health Program Requirements for Demolition Operations - American National Standard for Construction and Demolition Operations |

CARPET AND RUG INSTITUTE (CRI)

| | |
|---|---|
| CRI 104 | (2015) Carpet Installation Standard for Commercial Carpet |
| CRI 105 | (2015) Carpet Installation Standard for Residential Carpet |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2014) Safety -- 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; https://www.dla.mil/Portals/104/Documents/DispositionS /ddsr/docs/cylinderjointpub.pdf |

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

1.2.1 Definitions

1.2.1.1 Demolition

Demolition is the process of tearing apart and removing any feature 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 Plan

Prepare a Demolition Plan and submit proposed salvage 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, and a detailed description of methods and equipment to be used for each operation and of the sequence of operations. 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 must be approved by Contracting Officer prior to work beginning.

1.2.3 General Requirements

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the building. 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

Comply with FAR 52.236-9 to protect existing vegetation, structures, equipment, utilities, and improvements. 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, or demolition work performed under this contract. Do not overload structural elements and pavements to remain. Provide new supports and reinforcement for existing construction weakened by demolition 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 Utility Service

Maintain existing utilities indicated 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.

1.3.4 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 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, 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 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available at contract award.

## 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-01 Preconstruction Submittals

Demolition Plan; G-AE

Existing Conditions

SD-07 Certificates

Notification; G-RO

SD-11 Closeout Submittals

Receipts

## 1.7 QUALITY ASSURANCE

Submit timely notification of demolition and renovation projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA), the State's environmental protection agency, and 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.

### 1.7.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard 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. Vacuum and dust the work area daily. Sweep pavements as often as necessary to control the spread of debris that may result in foreign object damage potential to aircraft.

## 1.8 PROTECTION

### 1.8.1 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. Perform light

construction and installation in compliance with FAA AC 70/7460-1. Lights must 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.

1.8.2 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.

1.9 FOREIGN OBJECT DAMAGE (FOD)

Aircraft and aircraft engines are subject to FOD from debris and waste material lying on airfield pavements. Remove all such materials that may appear on operational aircraft pavements due to the Contractor's operations. If necessary, the Contracting Officer may require the Contractor to install a temporary barricade at the Contractor's expense to control the spread of FOD potential debris. Provide a barricade consisting of a fence covered with a fabric designed to stop the spread of debris. Anchor the fence and fabric to prevent displacement by winds or jet/prop blasts. Remove barricade when no longer required.

1.10 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.

1.11 EXISTING CONDITIONS

Before beginning any demolition 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 or the Contracting Officer's Representative showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs or electronic images with a minimum resolution of 3072 x 2304 pixels, capable of a print resolution of 300 dpi, 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 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 to the Contracting Officer or the Contracting Officer's Representative.

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 of structures.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Disassemble existing construction scheduled to be removed for reuse. 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. Designate materials for reuse onsite whenever possible.

3.1.1 Structures

a. Remove existing structures indicated to be removed to top of foundation walls. Remove interior walls, other than retaining walls and partitions, to top of concrete slab on ground. 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 equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

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 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated. Provide neat sawcuts at limits of pavement removal as indicated. Move, grind and store pavement and slabs designated to be recycled and utilized in this project as directed by the Contracting Officer. Remove pavement and slabs not to be used in this project from the installation at Contractor's expense.

### 3.1.4 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, abut or tie the new work into the existing construction as indicated. Provide square, straight edges and corners where existing masonry adjoins new work and other locations.

### 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. Do not use flame-cutting torches. 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. Scrap metal is the Contractor's property. Recycle scrap metal as part of demolition 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 Carpentry

Salvage for recycle lumber, millwork items, and finished boards, and sort by type and size. Chip or shred and recycle salvaged wood unfit for reuse, except stained, painted, or treated wood. Remove windows, doors, frames, and cabinets, and similar items as whole units, complete with trim and accessories. Brace the open end of door frames to prevent damage.

3.1.9 Carpet

Remove existing carpet for reclamation in accordance with manufacturer recommendations and as follows. Remove used carpet in large pieces, roll tightly, and pack neatly in a container. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI). Provide adhesive removal solvents in compliance with CRI 104/CRI 105. Recycle removed carpet cushion.

3.1.10 Acoustic Ceiling Tile

Remove, neatly stack, and recycle acoustic ceiling tiles. Recycling may be available with manufacturer. Otherwise, give priority to a local recycling organization. Recycling is not required if the tiles contain or may have been exposed to asbestos material.

3.1.11 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. Make finished surfaces of patched area flush with the adjacent existing surface and match the existing adjacent surface as closely as possible to texture and finish. Provide patching as specified and indicated, and include the following:

a. Concrete and Masonry: Completely fill holes and depressions, caused by previous physical damage or 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.

b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.

c. Patch acoustic lay-in ceiling where partitions have been removed. Make the transition between the different ceiling heights by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.1.12 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. Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.13 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.14 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.

3.1.15 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; provide to recycling service for disassembly and recycling of parts.

3.1.15.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; drain tanks, piping and fixtures; if previously used to store flammable, explosive, or other dangerous liquids, steam clean interiors. 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.

3.1.15.2 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, attach end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve 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.

3.1.15.3 Ducts

Classify removed duct work as scrap metal.

3.1.15.4 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.

3.1.16 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.

3.1.16.1 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.

3.1.16.2 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.

3.1.16.3 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.

3.1.16.4 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.

3.2 DISPOSITION OF MATERIAL

3.2.1 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, become the property of the Contractor and must be removed from Government property. Materials approved for storage by the Contracting Officer must be removed before completion of the contract. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer. 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.

3.2.2 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. Remove recovered ODS from Government property and dispose of in accordance with 40 CFR 82. Dispose products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) 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.

3.2.2.1 Special Instructions

No more than one type of ODS is permitted in each container. Apply a warning/hazardous label to the containers in accordance with Department of Transportation regulations. Provide a tag with the following information on all cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS:

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).

3.2.2.2 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.

3.2.3 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.

3.2.4 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material off of the installation.

3.3 CLEANUP

Remove debris and rubbish from project site 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.

3.4 DISPOSAL OF REMOVED MATERIALS

3.4.1 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 . Storage of removed materials on the project site is prohibited.

3.4.2 Burning on Government Property

Burning of materials removed from demolished structures will not be

permitted on Government property.

3.4.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition structures to designated spoil areas on Government property.

3.4.4 Removal from Government Property

Transport waste materials removed from demolished structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.5 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 --

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SECTION 02 61 13

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL
**02/10, CHG 1: 02/21**

PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

1.1.1 Measurement

Measurement for excavation and onsite transportation shall be based on the actual number of cubic yards of contaminated material in-place prior to excavation. Determination of the volume of contaminated material excavated shall be based on cross-sectional volume determination reflecting the differential between the original elevations of the top of the contaminated material and the final elevations after removal of the contaminated material. Measurement for backfilling of excavated areas shall be based on in-place cubic yards of compacted fill. Measurement for construction of stockpile areas shall be based on the number of square yards of stockpile liner constructed.

1.1.2 Payment

1.1.2.1 Excavation and Transportation

Compensation for excavation and onsite transportation of contaminated material will be paid as a unit cost. This unit cost shall include any other items incidental to excavation and handling not defined as having a specific unit cost.

1.1.2.2 Backfilling

Compensation for backfill soil, transportation of backfill, backfill soil conditioning, backfilling, compaction, and geotechnical testing will be paid as a single unit cost.

1.1.2.3 Stockpiling

Compensation for construction of stockpile areas will be paid for as a unit cost. This unit cost shall include all aspects of grading, preparation, handling, placement, maintenance, removal, treatment, and disposal of stockpile cover materials and liner materials and all other items incidental to construction of stockpiles.

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 D5434 | (2012) Field Logging of Subsurface Explorations of Soil and Rock |

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1926 | Safety and Health Regulations for Construction |
| 40 CFR 302 | Designation, Reportable Quantities, and Notification |

1.3 DESCRIPTION OF WORK

Notify the Contracting Officer within 24 hours, and before excavation, if contaminated material is discovered that has not been previously identified or if other discrepancies between data provided and actual field conditions are discovered. Backfill material is not available onsite. Required sampling and chemical analysis shall be conducted in accordance with state and local regulations pertaining to waste characterization sampling. Additionally, frequency of sampling for waste characterization and disposal will be based off the requirements of the waste acceptance facility. The waste acceptance facility may also have additional characterization sampling requirements.

1.3.1 Scheduling

Notify the Contracting Officer at least 14 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.

1.3.2 Work Plan

Submit a Work Plan within 30 calendar days after notice to proceed. No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is approved. Allow 30 calendar days in the schedule for the Government's review. 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 shall 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.

1.3.3 Other Submittal Requirements

Submit separate cross-sections of each area before and after excavation and after backfilling, test results, and copies of the Closure Report within 14 calendar days of work completion at the site.

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 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

Work Plan

SD-02 Shop Drawings

Surveys; G-AE

SD-06 Test Reports

Compaction

Closure Report

1.5 REGULATORY REQUIREMENTS

1.5.1 Permits and Licenses

Obtain required federal, state, and local permits for excavation and storage of contaminated material. Permits shall be obtained at no additional cost to the Government.

1.5.2 Air Emissions

Air emissions shall be monitored and controlled in accordance with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

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. Spill response materials shall be available at all times when contaminated materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

2.2 BACKFILL

Refer to 31 00 00 EARTHWORK for backfill instructions.

Do not use material for backfill until borrow source chemical and physical test results have been submitted and approved.

## PART 3 EXECUTION

### 3.1 SURVEYS

Perform surveys immediately prior to and after excavation of contaminated material to determine the volume of contaminated material removed. Also, perform surveys immediately after backfill of each excavation. Provide cross-sections on 25 foot intervals and at break points for all excavated areas. Locations of confirmation samples shall also be surveyed and shown on the drawings.

### 3.2 EXISTING STRUCTURES AND UTILITIES

No excavation shall be performed until site utilities have been field located. 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 shall be repaired at no additional cost to the Government. Utilities encountered that were not previously shown or otherwise located shall not be disturbed without approval from the Contracting Officer.

### 3.3 CLEARING

Clearing shall be performed to the limits shown on the drawings.

### 3.4 CONTAMINATED MATERIAL REMOVAL

#### 3.4.1 Excavation

Areas of contamination shall be excavated to the depth and extent shown on the drawings and not more than 0.2 ft beyond the depth and extent shown on the drawings unless directed by the Contracting Officer. Excavation shall be performed in a manner that will limit spills and the potential for contaminated material to be mixed with uncontaminated material. An excavation log describing visible signs of contamination encountered shall be maintained for each area of excavation. Excavation logs shall be prepared in accordance with ASTM D5434.

#### 3.4.2 Shoring

If workers must enter the excavation, it shall be evaluated, shored, sloped or braced as required by EM 385-1-1 and 29 CFR 1926 section 650.

#### 3.4.3 Dewatering

Surface water shall be diverted to prevent entry into the excavation. Dewatering shall be limited to that necessary to assure adequate access, a safe excavation, prevent the spread of contamination, and to ensure that compaction requirements can be met.

### 3.5 CONFIRMATION SAMPLING AND ANALYSIS

The Contracting Officer shall be present to inspect the removal of contaminated material from each site. After all material suspected of being contaminated has been removed, the excavation shall be examined for evidence of contamination. If the excavation appears to be free of contamination, field analysis shall be used to determine the presence of contamination using a real time vapor monitoring instrument. Excavation

of additional material shall be as directed by the Contracting Officer.

## 3.6 CONTAMINATED MATERIAL STORAGE

Material shall be placed in temporary storage immediately after excavation. The following paragraphs describe acceptable methods of material storage. Storage units shall be in good condition and constructed of materials that are compatible with the material or liquid to be stored. If multiple storage units are required, each unit shall be clearly labeled with an identification number and a written log shall be kept to track the source of contaminated material in each temporary storage unit.

### 3.6.1 Stockpiles

Stockpiles shall be constructed to isolate stored contaminated material from the environment. Stockpiles shall be constructed to include:

a. A chemically resistant geomembrane liner free of holes and other damage. Non-reinforced geomembrane liners shall have a minimum thickness of 20 mils. Scrim reinforced geomembrane liners shall have a minimum weight of 40 lbs/1000 square feet. The ground surface on which the geomembrane is to be placed shall 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 shall have a minimum thickness of 10 mils. Scrim reinforced geomembrane covers shall have a minimum weight of 26 lbs/1000 square feet. The cover material shall be extended 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. Vehicle access points shall also be bermed.

d. The liner system shall be sloped to allow collection of leachate. Storage and removal of liquid which collects in the stockpile, in accordance with paragraph Liquid Storage.

### 3.6.2 Roll-Off Units

Roll-off units used to temporarily store contaminated material shall be water tight. A cover shall be placed over the units to prevent precipitation from contacting the stored material. The units shall be located as shown on the drawings. Liquid which collects inside the units shall be removed and stored in accordance with paragraph Liquid Storage. Roll-off will be covered at all times except when actively being filled.

### 3.6.3 Liquid Storage

Liquid collected from excavations and stockpiles shall be temporarily stored in 55 gallon barrels or appropriate sized water storage tanks. Liquid storage containers shall be water-tight and shall be located as indicated.

## 3.7 SAMPLING

### 3.7.1 Sampling of Stored Material

Samples of stored material shall be collected at a frequency as determined by the waste disposal facility. Waste characterization sampling parameters will be determined by the waste disposal facility, and applicable state and federal rules and regulations.

Stored material with contaminant levels that exceed the action levels shall be treated offsite. Analyses for contaminated material to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the Contracting Officer. Additional sampling and analyses to the extent required by the approved offsite treatment, storage or disposal (TSD) facility shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

### 3.7.2 Sampling Liquid

Liquid collected from excavations and decontamination facilities shall be sampled at a frequency as determined by the liquid waste disposal facility.

Liquid with contaminant levels that exceed action levels shall be treated offsite. Analyses for contaminated liquid to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the Contracting Officer. Additional sampling and analysis to the extent required by the approved offsite treatment, storage or disposal (TSD) facility receiving the material shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

### 3.7.3 Sampling Beneath Storage Units

Samples from beneath each storage unit shall be collected prior to construction of and after removal of the storage unit. Samples shall be collected at a frequency as determined by the waste disposal facility and applicable state and federal rules and regulations, and from a depth interval of 0 to 0.5 feet and shall be tested.

Based on test results, soil which has become contaminated above action levels shall be removed at no additional cost to the Government. Contaminated material which is removed from beneath the storage unit shall be handled in accordance with paragraph Sampling of Stored Material. As directed by the Contracting Officer and at no additional cost to the Government, additional sampling and testing shall be performed to verify areas of contamination found beneath stockpiles have been cleaned up to below action levels.

## 3.8 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 Base Wide Contingency Plan for immediate reporting and containment. Immediate containment

actions shall be taken to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local regulations. As directed by the Contracting Officer, additional sampling and testing shall be performed to verify spills have been cleaned up. Spill cleanup and testing shall be done at no additional cost to the Government.

## 3.9 BACKFILLING

### 3.9.1 Confirmation Test Results

Excavations shall be backfilled immediately after all contaminated materials have been removed and confirmation test results have been approved. Backfill shall be placed and compacted to the lines and grades shown on the drawings.

### 3.9.2 Compaction

Refer to 31 00 00 EARTHWORK for compaction instructions.

## 3.10 DISPOSAL REQUIREMENTS

Offsite disposal of contaminated material shall be in accordance with Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

## 3.11 CLOSURE REPORT

Submit two copies of a Closure Report within 14 calendar days of completing work at the site. The report shall be labeled with the contract number, project name, location, date, name of general Contractor, and the Corps of Engineers District contracting for the work. The Closure Report shall include the following information as a minimum:

a. A cover letter signed by a responsible company official who is 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. On-site stockpile, storage, treatment, loading, and disposal areas shall also be shown on the drawings.

h. Progress Photographs. Color photographs shall be used to document progress of the work. 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, activities at each work location shall be photographically recorded daily. Photographs shall 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.

A digital version of all photos shown in the report shall be included with the Closure Report. Photographs shall 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. Each print shall have an information box attached. The box shall be typewritten and arranged as follows:

| | |
|---|---|
| Project Name: | Direction of View: |
| Location: | Date/Time: |
| Photograph No.: | Description of View: |

-- End of Section --

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SECTION 02 81 00

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**11/18**

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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. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 385-1-1 | (2014) Safety -- Safety and Health Requirements Manual |
| EP 415-1-266 | (2000) Resident Engineer Management Guide (REMG) for Hazardous, Toxic, and Radioactive Waste (HTRW) Projects |

U.S. DEPARTMENT OF TRANSPORTATION (DOT)

| | |
|---|---|
| DOT 4500.9R | Defense Transportation Regulation, Part 2, Cargo Movement, Chapter 204, Hazardous Material |

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

| | |
|---|---|
| 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 |
| 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 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 |

## 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 172.101 and 49 CFR 172.102 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" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Packaging Notifications

Hazardous Waste Management Plan; G

(The Hazardous Waste Management Plan shall be reviewed and approved by the installation Hazardous Waste Program Manager (HWPM) 28 CES/CEIE.)

Safety Data Sheets (SDSs); G

Onsite Hazardous Waste Management; G

Notices of Non-Compliance and Notices of Violation

SD-06 Test Reports

Waste Analysis Reports; G

Recordkeeping; G

Exception Report; G

Spill Response

SD-07 Certificates

Transportation and Disposal Coordinator; G

Training; G

Certification

Shipping Documents and Packagings 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, polychlorinated biphenyl (PCB) manifests, bill of ladings, exception and discrepancy reports; 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 DOT-certified under 49 CFR 172, Subpart H.

The Contractor is responsible to manifest and dispose of all hazardous waste, generated during the project, at a proper EPA permitted Treatment, Storage, and Disposal Facility (TSDF). The Transportation and Disposal Coordinator must ensure that no shipments of hazardous waste from Ellsworth AFB occur until the installation Hazardous Waste Program Manager has reviewed the shipment and has signed the Uniform Hazardous Waste Manifest. The Transportation and Disposal Coordinator will ensure all hazardous waste generated during the project is properly collected and containerized in containers suitable to meet Department of Transportation (DOT) shipping requirements for the waste. The Transportation and Disposal Coordinator will ensure the containers are approved by the installation HWPM prior to use. Small amounts of hazardous waste may be allowed to be disposed of through the HAZMART on a case by case basis, which is decided by the installation HWPM. The Transportation and Disposal Coordinator will verify the waste is allowed to be disposed of through HAZMART and will be delivered to the HAZMART facility in the DOT-approved containers. The Contractor will provide the HAZMART contractor with copies of all waste analysis reports, Safety Data Sheets, and any other documentation used to characterize the waste.

### 1.4.2 Training

Proper hazardous waste training must be provided for all personnel who handle hazardous waste and their supervisors in accordance with EPA federal regulations 40 CFR 262.17 (a) (7). Hazardous materials employees must be trained, tested, and certified to safely and effectively carry out their assigned duties. Employees transporting hazardous materials or preparing hazardous materials for transportation, including samples, must be trained, tested, and certified in accordance with 49 CFR 172, Subpart H, including security awareness and any applicable security plans. Employees must be trained, tested, and certified in accordance with 49 CFR 172, Subpart H to ensure shipments meet all requirements for DOT regulated hazardous materials.

Keep training records onsite during the project and for an additional three years after the project is completed.

### 1.4.3 Certification

The hazardous materials transporter must possess a current certificate of registration issued by the Research and Special Programs Administration (RSPA), DOT, 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 which are applicable. 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 waste containers at Hazardous

Waste Satellite Accumulation Points and hazardous materials in conformance with DOT and EP 415-1-266. Details in this specification must not be construed as establishing the limits of the Contractor's responsibility.

2.1.1 Packagings

Provide bulk containers for packaging hazardous materials/wastes consistent with the authorizations referenced in the Hazardous Materials Table in 49 CFR 172.101, Column 8. Bulk and non-bulk packaging must meet the corresponding specifications in 49 CFR 173 referenced in the Hazardous Materials Table, 49 CFR 172.101. Packaging must conform to the general packaging requirements 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 172.101, 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 264.314. In addition, packaging notifications will be provided to the Government in accordance with 49 CFR 172.178.2(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 262.32 (for hazardous waste); 40 CFR 761.45 (for PCBs); and 40 CFR 61.149(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 172.101, 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

The Ellsworth AFB HWPM will determine sampling requirements for all necessary hazardous constituents that may be present in the waste. The Contractor shall properly sample all wastes, in accordance with EPA SW-846, suspected to be hazardous wastes as defined by the Resource Conservation and Recovery Act (RCRA).

The Contractor is responsible to manifest and dispose of all hazardous waste generated during the project at a proper EPA permitted Treatment, Storage, and Disposal (TSD) facility. No shipments of hazardous waste from Ellsworth AFB can occur until the HWPM has reviewed the shipment and has signed the Uniform Hazardous Waste Manifest. The Contractor will properly containerize and label all hazardous waste generated during the project in containers suitable to meet DOT shipping requirements for the waste. Prior to use, the Ellsworth AFB HWPM must approve all containers the Contractor will use for the collection of hazardous waste disposal. Small amounts of hazardous waste may be allowed to be disposed of through the HAZMART on a case by case basis, which is decided by the installation HWPM. The Contractor must deliver the waste allowed to be disposed of through HAZMART to the HAZMART facility in the DOT-approved containers. The Contractor will provide the HAZMART Contractor with copies of all waste analysis reports, Safety Data Sheets (SDSs), and any other documentation used to characterize the waste.

The Contractor must dispose of all universal waste (i.e., fluorescent lamps, HID lamps, mercury-containing thermostats, etc.), PCB waste (i.e., PCB small transformers, PCB lighting ballasts, and PCB contaminated waste from spill cleanup), and used oil through the HAZMART. Universal waste and PCB waste must be properly containerized in DOT-approved shipping containers approved by the HWPM. The Contractor will deliver all universal waste and PCB waste requiring disposal to the HAZMART. The Contractor will deliver any used oil to the HAZMART to be added to the large used oil storage tank at the facility.

3.1 HAZARDOUS WASTE MANAGEMENT PLAN

The Contractor shall 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 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.

Prior to commencing work and removal of any waste from Ellsworth AFB, the Contractor must submit the Hazardous Waste Management Plan to the Ellsworth AFB HWPM for review and approval. The Ellsworth AFB HWPM will determine if the Contractor's plan meets all of the requirements for proper management of hazardous waste for Ellsworth AFB. The HWPM will need to approve any TSD facility used for disposal of hazardous waste from Ellsworth AFB. Submit the plan to 28 CES/CEIE and the Contracting Officer for approval prior to start of work. Submit written documentation of weekly hazardous waste inspections on a monthly basis.

3.1.1 On-Site Training

Prior to starting on-site Work, conduct a health and safety training class directed by the SSHO to discuss the implementation of the SSHP. Notify the Contracting Officer 24 hours prior to beginning the training class.

3.1.2 Respiratory Protection Program

Fully employ respiratory protection program, addressing respirator usage and training, in accordance with 29 CFR 1910 and EM 385-1-1.

3.2 ONSITE HAZARDOUS WASTE MANAGEMENT

Coordinate the onsite management of all hazardous materials and waste with the installation 28 CES/CEIE, the environmental function, and the Contracting Officer. These paragraphs apply to waste generated on Ellsworth AFB. 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 Large Quantity Hazardous Waste Generator requirements in 40 CFR 262 and applicable state or local law or regulations when accumulating hazardous waste onsite. Onsite accumulation times must be restricted to applicable time frames referenced in 40 CFR 262.17 and applicable state or local law or regulation. Accumulation start dates commence when the accumulation container becomes full and is required to be transferred into a 90-day accumulation site. Only use containers in good condition and compatible with the waste to be stored. Ensure containers are closed except when adding or removing waste; immediately mark all hazardous waste containers with the words "hazardous waste" and the words "ignitable", "corrosive", "toxic" and/or "reactive" depending on the characteristics of the waste and other information required by 40 CFR 262.17 and applicable state or local law or regulation as soon as the waste is containerized. An additional marking must be placed 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 installation HWPM, 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 the installation HWPM for review and approval.

## 3.3 OFFSITE HAZARDOUS WASTE MANAGEMENT

No shipments of hazardous waste from Ellsworth AFB can occur until the HWPM has reviewed the shipment and has signed the Uniform Hazardous Waste Manifest. The Contractor will properly containerize and label all hazardous waste generated during the project in containers suitable to meet DOT shipping requirements for the waste. Prior to use, the Ellsworth AFB HWPM must approve all containers the contractor will use for the collection of hazardous waste disposal. Small amounts of hazardous waste may be allowed to be disposed of through the HAZMART on a case by case basis, which is determined by the installation HWPM. The Contractor must deliver the waste allowed to be disposed of through HAZMART to the HAZMART facility in the DOT-approved containers. The Contractor will provide the HAZMART Contractor with copies of all waste analysis reports, SDSs, and any other documentation used to characterize the waste.

Coordinate the off site transfer of all hazardous materials and waste with the installation environmental function and the Contracting Officer. Use 28 CES/CEIE approved 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 TSD 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 28 CES/CEIE and the Contracting Officer. Also furnish relevant documents regarding the incident and any information requested by 28 CES/CEIE and the Contracting Officer, and coordinate its response to the notice with 28 CES/CEIE and the Contracting Officer or the designated representative prior to submission to the notifying authority. Also furnish a copy to 28 CES/CEIE and 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 TSD Facility and Transporter

Provide 28 CES/CEIE and the Contracting Officer with EPA ID numbers, names, locations, and telephone numbers of TSD facilities and transporters. This information must be contained in the Hazardous Waste Management Plan and be approved by 28 CES/CEIE and 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.

### 3.3.3 Shipping Documents and Packagings Certification

No shipments of hazardous waste from Ellsworth AFB can occur until the

HWPM has reviewed the shipment and has signed the Uniform Hazardous Waste Manifest. The Contractor will properly containerize and label all hazardous waste generated during the project in containers suitable to meet DOT shipping requirements for the waste. Prior to use, the Ellsworth AFB HWPM must approve all containers the Contractor will use for the collection of hazardous waste disposal. Small amounts of hazardous waste may be allowed to be disposed of through the HAZMART on a case by case basis, which is decided by the installation HWPM. The Contractor must deliver the waste allowed to be disposed of through HAZMART to the HAZMART facility in the DOT-approved containers. The Contractor will provide the HAZMART Contractor with copies of all waste analysis reports, SDSs, and any other documentation used to characterize the waste.

Prior to shipment of any hazardous waste offsite and a minimum of 14 days prior to anticipated pickup, provide for review written certification to the installation HWPM and the Contracting Officer that hazardous materials have been properly packaged, labeled, and marked in accordance with Department of Transportation and EPA requirements. The installation HWPM must review each shipment and sign the Uniform Hazardous Waste Manifest prior to any hazardous waste leaving the installation. Furnish a copy of the manifest signed by the designated disposal facility not later than 35 days after acceptance of the shipment.

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 Parts 100-185. 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 the installation HWPM for review and approval. The manifests shall contain the amount (weight) and supporting analytical laboratory results. Coordinate with the installation HWPM in preparing 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 installation HWMP for review and approval. In accordance with DOT 4500.9R, inspect motor vehicles used to transport hazardous materials in accordance the 49 CFR and DOT safety regulations and complete DD Form 626, Motor Vehicle Inspection.

3.3.5 Treatment and Disposal of Hazardous Wastes

No shipments of hazardous waste from Ellsworth AFB can occur until the HWPM has reviewed the shipment and has signed the Uniform Hazardous Waste Manifest. The Contractor will properly containerize and label all hazardous waste generated during the project in containers suitable to meet DOT shipping requirements for the waste. Prior to use, the Ellsworth AFB HWPM must approve all containers the Contractor will use for the collection of hazardous waste disposal. Small amounts of hazardous waste may be allowed to be disposed of through the HAZMART on a case by case basis, which is decided by the installation HWPM. The Contractor must

deliver the waste allowed to be disposed of through HAZMART to the HAZMART facility in the DOT-approved containers. The Contractor will provide the HAZMART Contractor with copies of all waste analysis reports, SDSs, and any other documentation used to characterize the waste.

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, it must be transferred to an on-site 90-day accumulation area, or a permitted hazardous waste TSD 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, that must be approved by the installation HWPM. Submit Certificates of Disposal documenting the ultimate disposal, destruction or placement of hazardous wastes and asbestos within 180 days of initial shipment. Receipt of these certificates will be required for final payment.

## 3.4 MATERIALS MANAGEMENT

The Ellsworth AFB HWPM will determine sampling requirements for all necessary hazardous constituents that may be present in the waste. The Contractor shall properly sample all wastes, in accordance with EPA SW-846, suspected to be hazardous wastes as defined by the Resource Conservation and Recovery Act (RCRA).

The Contractor is responsible to manifest and dispose of all hazardous waste generated during the project at a proper EPA permitted TSD facility. No shipments of hazardous waste from Ellsworth AFB can occur until the HWPM has reviewed the shipment and has signed the Uniform Hazardous Waste Manifest. The Contractor will properly containerize and label all hazardous waste generated during the project in containers suitable to meet DOT shipping requirements for the waste. Prior to use, the Ellsworth AFB HWPM must approve all containers the Contractor will use for the collection of hazardous waste disposal. Small amounts of hazardous waste may be allowed to be disposed of through the HAZMART on a case by case basis, which is determined by the installation HWPM. The Contractor must deliver the waste allowed to be disposed of through HAZMART to the HAZMART facility in the DOT-approved containers. The Contractor will provide the HAZMART Contractor with copies of all waste analysis reports, Safety Data Sheets (SDSs), and any other documentation used to characterize the waste.

The Contractor must dispose of all universal waste (i.e., fluorescent lamps, HID lamps, mercury-containing thermostats, etc.), PCB waste (i.e., PCB small transformers, PCB lighting ballasts, and PCB contaminated waste from spill cleanup), and used oil through the HAZMART. Universal waste and PCB waste must be properly containerized in DOT-approved shipping containers approved by the HWMP. The Contractor will deliver all universal waste and PCB waste requiring disposal to the HAZMART. The Contractor will deliver any used oil to the HAZMART to be added to the large used oil storage tank at the facility.

Consult with the installation HWPM to evaluate, prior to shipment of any material offsite, whether the material is regulated as a hazardous waste. Perform the evaluation to determine proper shipping descriptions, marking

requirements, and other criteria, as described below.

3.4.1 Identification of Proper Shipping Names

Use 49 CFR 172.101 to identify proper shipping names for each hazardous material (including hazardous wastes) to be shipped offsite. Submit proper shipping names to the installation HWPM in the form of draft shipping documents for review and approval.

3.4.2 Packaging, Labeling, and Marking

The Contractor will properly containerize and label all hazardous waste generated during the project in containers suitable to meet DOT shipping requirements for the waste. Prior to use, the Ellsworth AFB HWPM must approve all containers the Contractor will use for the collection of hazardous waste disposal. The Contractor shall package, label, and mark hazardous materials/wastes using the specified materials and in accordance with the referenced authorizations. A photograph of the label to be used is included as an Attachment. Mark each container of hazardous waste of 110 gallons or less with the following:

"HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal.
If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.
Generator's name _____
Manifest Document Number _____".

3.4.3 Shipping Documents

The Contractor is responsible to manifest and dispose of all hazardous waste generated during the project at a proper EPA permitted TSD facility. No shipments of hazardous waste from Ellsworth AFB can occur until the HWPM has reviewed the shipment and has signed the Uniform Hazardous Waste Manifest. The Contractor shall verify that each shipment of hazardous material sent offsite is accompanied by properly completed shipping documents. This includes shipments of samples that may potentially meet the definition of a Department of Transportation regulated hazardous material.

3.4.3.1 PCB Waste Shipment Documents

The Contractor must dispose of all universal waste (i.e., fluorescent lamps, HID lamps, mercury-containing thermostats, etc.), PCB waste (i.e., PCB small transformers, PCB lighting ballasts, and PCB contaminated waste from spill cleanup), and used oil through the HAZMART. Universal waste and PCB waste must be properly containerized in DOT-approved shipping containers approved by the HWMP. The Contractor will deliver all universal waste and PCB waste requiring disposal to the HAZMART.

3.4.3.2 Asbestos Waste Shipment Documents

Prepare waste shipment records, as required by 40 CFR 61, for shipments of asbestos. Submit waste shipment records to 28 CES/CEIE and the Contracting Officer for review and approval. Waste shipment records must be signed by the Contractor.

3.4.3.3 Other Hazardous Material Shipment Documents

The Contractor shall prepare a bill of lading for each shipment of

hazardous material which is not accompanied by a hazardous waste manifest or asbestos waste shipment record which fulfills the shipping paper requirements. Any bill of lading or other types of shipping papers must reviewed and approved by the installation HWPM before the material can be shipped from Ellsworth AFB. The Contractor is required to turn in used oil generated on site to the HAZMART for disposal. The Contractor shall not ship used oil off of Ellsworth AFB. For laboratory samples and treatability study samples, prepare bills of lading and other documentation as necessary to satisfy conditions of the sample exclusions in 40 CFR 261.4(d) and (e) and any applicable state or local law or regulation. If shipping hazardous materials that are not a waste generated on site, the person signing the shipping papers must have the proper DOT training certifying they can sign the required documents. If the hazardous material is a waste, shipping documents must be signed by the HWPM.

## 3.5 OBTAINING EPA ID NUMBERS

All waste generated on the base will utilize the base EPA ID Number for disposal.

## 3.6 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.

## 3.7 RECORDKEEPING

Maintain adequate records to support information provided to 28 CES/CEIE and the Contracting Officer regarding exception reports, annual reports, and biennial reports; maintain asbestos waste shipment records for a minimum of 3 years from the date of shipment or any longer period required by applicable law or regulation or other provision of this contract; and maintain bill of ladings for a minimum of 3 years 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 28 CES/CEIE or 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 TSD facility is not received within 35 days of shipment initiation, or that a manifest copy documenting receipt of PCB waste at the designated facility is not received within 35 days of shipment initiation, follow up with the TSD to determine the status of the shipment and when a copy of the manifest will be provided. Coordinate with the installation HWPM and the Contracting Officer to complete an exception

report within 37 days of shipment initiation, if a copy of the manifest has not been received. The installation HWMP will submit the exception report to the State SD DANR or EPA within the required time limits.

## 3.8 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.

## 3.9 EMERGENCY CONTACTS

Comply with the emergency contact provisions in 49 CFR 172.604. Whenever the Contractor ships hazardous materials, provide a 24-hour 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.

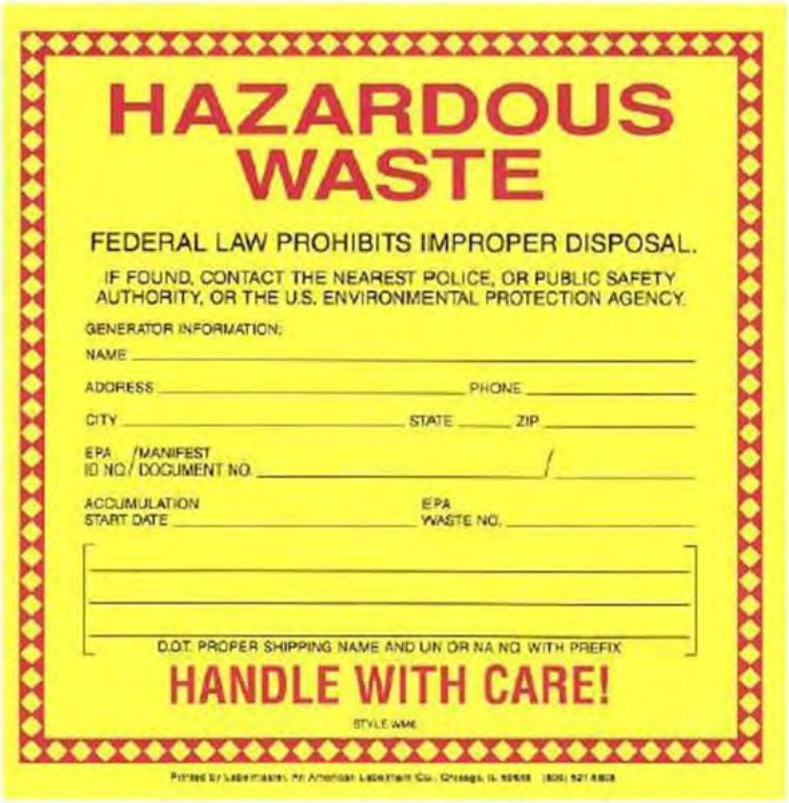
b. Phone number through which the emergency coordinator can be contacted on a 24-hour basis.

c. The telephone number of the local fire department.

d. The location of fire extinguishers and spill control materials.

| Attachment A<br>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 --




Photograph of hazardous materials/wastes label to be used.

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SECTION 02 82 00

ASBESTOS REMEDIATION
**11/18, 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 SOCIETY OF SAFETY PROFESSIONALS (ASSP)

| | |
|---|---|
| ASSP Z9.2 | (2018) Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C732 | (2006; R 2012) Aging Effects of Artificial Weathering on Latex Sealants |
| ASTM D4397 | (2016) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications |
| ASTM E84 | (2020) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E96/E96M | (2022) Standard Test Methods for Gravimetric Determination ofWater Vapor Transmission Rate of Materials |
| ASTM E119 | (2020) Standard Test Methods for Fire Tests of Building Construction and Materials |
| ASTM E736/E736M | (2017) Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members |
| ASTM E1368 | (2014) Visual Inspection of Asbestos Abatement Projects |

COMPRESSED GAS ASSOCIATION (CGA)

| | |
|---|---|
| CGA G-7 | (2014) Compressed Air for Human Respiration; 6th Edition |

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

| | |
|---|---|
| ANSI/ISEA Z87.1 | (2020) Occupational and Educational Personal Eye and Face Protection Devices |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 701 | (2019) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films |

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

| | |
|---|---|
| NIOSH NMAM | (2016; 5th Ed) NIOSH Manual of Analytical Methods |

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 340/1-90/018 | (1990) Asbestos/NESHAP Regulated Asbestos Containing Materials Guidance |
| EPA 560/5-85-024 | (1985) Guidance for Controlling Asbestos-Containing Materials in Buildings (Purple Book) |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.147 | The Control of Hazardous Energy (Lock Out/Tag Out) |
| 29 CFR 1926.51 | Sanitation |
| 29 CFR 1926.59 | Hazard Communication |
| 29 CFR 1926.103 | Respiratory Protection |
| 29 CFR 1926.200 | Accident Prevention Signs and Tags |
| 29 CFR 1926.1101 | Asbestos |
| 40 CFR 61-SUBPART A | General Provisions |
| 40 CFR 61-SUBPART M | National Emission Standard for Asbestos |
| 40 CFR 763 | Asbestos |
| 42 CFR 84 | Approval of Respiratory Protective Devices |
| 49 CFR 107 | Hazardous Materials Program Procedures |
| 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 173 | Shippers - General Requirements for |

Shipments and Packagings

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 586 | (2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units |

1.2 DEFINITIONS

1.2.1 ACM

Asbestos Containing Materials.

1.2.2 Amended Water

Water containing a wetting agent or surfactant with a maximum surface tension of 0.00042 psi.

1.2.3 Area Sampling

Sampling of asbestos fiber concentrations which approximates the concentrations of asbestos in the theoretical breathing zone but is not actually collected in the breathing zone of an employee.

1.2.4 Asbestos

The term asbestos includes chrysotile, amosite, crocidolite, tremolite asbestos, anthophyllite asbestos, and actinolite asbestos and any of these minerals that has been chemically treated or altered. Materials are considered to contain asbestos if the asbestos content of the material is determined to be at least one percent.

1.2.5 Asbestos Control Area

That area where asbestos removal operations are performed which is isolated by physical boundaries which assist in the prevention of the uncontrolled release of asbestos dust, fibers, or debris.

1.2.6 Asbestos Fibers

Those fibers having an aspect ratio of at least 3:1 and longer than 5 micrometers as determined by National Institute for Occupational Safety and Health (NIOSH) Method 7400.

1.2.7 Asbestos Permissible Exposure Limit

0.1 fibers per cubic centimeter of air as an 8-hour time weighted average measured in the breathing zone as defined by 29 CFR 1926.1101 or other Federal legislation having legal jurisdiction for the protection of workers health.

1.2.8 Authorized Person

Any person authorized by the Contractor and required by work duties to be present in the regulated areas.

1.2.9 Background

The ambient airborne asbestos concentration in an uncontaminated area as measured prior to any asbestos hazard abatement efforts. Background concentrations for other (contaminated) areas are measured in similar but asbestos free locations.

1.2.10 Competent Person (CP)

A person meeting the requirements for competent person as specified in 29 CFR 1926.1101 including a person capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure, who has the authority to take prompt corrective measures to eliminate them, and is specifically trained in a training course which meet the criteria of supervisor, or its equivalent. The competent person must have a current State of South Dakota asbestos contractors or supervisors license.

1.2.11 Contractor

The Contractor is that individual, or entity under contract to perform the herein listed work.

1.2.12 Disposal Bag

A 6 mil thick, leak-tight plastic bag, pre-labeled in accordance with 29 CFR 1926.1101, used for transporting asbestos waste from containment to disposal site.

1.2.13 Disturbance

Activities that disrupt the matrix of ACM, crumble or pulverize ACM, or generate visible debris from ACM. Disturbance includes cutting away small amounts of ACM, no greater than the amount which can be contained in one standard sized glovebag or waste bag, not larger than 60 inches in length and width in order to access a building component.

1.2.14 Encapsulation

The abatement of an asbestos hazard through the appropriate use of chemical encapsulants.

1.2.15 Encapsulants

Specific materials in various forms used to chemically or physically entrap asbestos fibers in various configurations to prevent these fibers from becoming airborne. There are four types of encapsulants as follows which must comply with performance requirements as specified herein.

a. Lock-Down Encapsulant (used to seal off or "lock-down" minute asbestos fibers left on surfaces from which asbestos containing material has been removed).

1.2.16 Friable Asbestos Material

A term defined in 40 CFR 61-SUBPART M and EPA 340/1-90/018 meaning any material which contains more than 1 percent asbestos, as determined using the method specified in 40 CFR 763, Polarized Light Microscopy (PLM), that when dry, can be crumbled, pulverized, or reduced to powder by hand

pressure.

1.2.17 Glovebag Technique

Those asbestos removal and control techniques put forth in 29 CFR 1926.1101.

1.2.18 Government Consultant (GC)

That qualified person employed directly by the Government to monitor, sample, inspect the work or in some other way advise the Contracting Officer. The GC is normally a private consultant, but can be an employee of the Government.

1.2.19 HEPA Filter Equipment

High efficiency particulate air (HEPA) filtered vacuum and exhaust ventilation equipment with a filter system capable of collecting and retaining asbestos fibers. Filters must retain 99.97 percent of particles 0.3 microns or larger as indicated in UL 586.

1.2.20 Negative Pressure Enclosure (NPE)

That engineering control technique described as a negative pressure enclosure in 29 CFR 1926.1101.

1.2.21 NESHAP

National Emission Standards for Hazardous Air Pollutants. The USEPA NESHAP regulation for asbestos is at 40 CFR 61-SUBPART M.

1.2.22 Nonfriable Asbestos Material

Material that contains asbestos in which the fibers have been immobilized by a bonding agent, coating, binder, or other material so that the asbestos is well bound and will not normally release asbestos fibers during any appropriate use, handling, storage or transportation. It is understood that asbestos fibers may be released under other conditions such as demolition, removal, or mishap.

1.2.23 Permissible Exposure Limits (PELs)

1.2.23.1 PEL-Time Weighted Average(TWA)

Concentration of asbestos not in excess of 0.1 fibers per cubic centimeter of air (f/cc) as an 8-hour time weighted average (TWA).

1.2.23.2 PEL-Excursion Limit

An airborne concentration of asbestos not in excess of 1.0 f/cc of air as averaged over a sampling period of 30 minutes.

1.2.24 Personal Sampling

Air sampling which is performed to determine asbestos fiber concentrations within the breathing zone of a specific employee, as performed in accordance with 29 CFR 1926.1101.

1.2.25 Private Qualified Person (PQP)

That qualified person hired by the Contractor to perform the herein listed tasks.

1.2.26 Qualified Person (QP)

A Registered Architect, Professional Engineer, Certified Industrial Hygienist, consultant or other qualified person who has successfully completed training and is therefore accredited under a legitimate State Model Accreditation Plan as described in 40 CFR 763 as a Building Inspector, Contractor/Supervisor Abatement Worker, and Asbestos Project Designer; and has successfully completed the National Institute of Occupational Safety and Health (NIOSH) 582 course "Sampling and Evaluating Airborne Asbestos Dust" or equivalent. The QP must be qualified to perform visual inspections as indicated in ASTM E1368. The QP must be appropriately licensed in the State of South Dakota.

1.2.27 TEM

Refers to Transmission Electron Microscopy.

1.2.28 Time Weighted Average (TWA)

The TWA is an 8-hour time weighted average airborne concentration of asbestos fibers.

1.2.29 Transite

A generic name for asbestos cement wallboard and pipe.

1.2.30 Wetting Agent

A chemical added to water to reduce the water's surface tension thereby increasing the water's ability to soak into the material to which it is applied. An equivalent wetting agent must have a surface tension of at most 0.00042 psi.

1.2.31 Worker

Individual (not designated as the Competent Person or a supervisor) who performs asbestos work and has completed asbestos worker training required by 29 CFR 1926.1101, to include EPA Model Accreditation Plan (MAP) "Worker" training; accreditation, if required by the OSHA Class of work to be performed or by the state where the work is to be performed. The worker must be appropriately licensed in the State of South Dakota.

1.3 REQUIREMENTS

1.3.1 Description of Work

The work covered by this section includes the handling and control of asbestos containing materials and describes some of the resultant procedures and equipment required to protect workers, the environment and occupants of the building or area, or both, from contact with airborne asbestos fibers. The work also includes the disposal of any asbestos containing materials generated by the work. More specific operational procedures must be outlined in the Asbestos Hazard Abatement Plan called for elsewhere in this specification. The asbestos work includes the

demolition and removal of asbestos containing materials located throughout. Refer to the attached Regulated Building Materials Survey. Provide negative pressure enclosure techniques as outlined in this specification. The work area will be evacuated during the asbestos abatement work. A competent person must supervise asbestos removal work as specified herein.

1.3.1.1 Wallboard/Joint Compound

Discrete samples of the components (wallboard and joint compound) have been tested and results are attached.

1.3.2 Unexpected Discovery of Asbestos

Notify the Contracting Officer if any previously untested building components suspected to contain asbestos are impacted by the work.

1.3.3 Medical Requirements

Provide medical requirements including but not limited to medical surveillance and medical record keeping as listed in 29 CFR 1926.1101.

1.3.3.1 Medical Examinations

Before exposure to airborne asbestos fibers, provide workers with a comprehensive medical examination as required by 29 CFR 1926.1101 or other pertinent State or local directives. This requirement must have been satisfied within the 12 months prior to the start of work on this contract. The same medical examination must be given on an annual basis to employees engaged in an occupation involving asbestos and within 30 calendar days before or after the termination of employment in such occupation. Specifically identify x-ray films of asbestos workers to the consulting radiologist and mark medical record jackets with the word "ASBESTOS."

1.3.3.2 Medical Records

Maintain complete and accurate records of employees' medical examinations, medical records, and exposure data for a period of 50 years after termination of employment and make records of the required medical examinations and exposure data available for inspection and copying to: The Assistant Secretary of Labor for Occupational Safety and Health (OSHA), or authorized representatives of them, and an employee's physician upon the request of the employee or former employee.

1.3.4 Employee Training

Submit certificates, prior to the start of work but after the main abatement submittal, signed by each employee indicating that the employee has received training in the proper handling of materials and wastes that contain asbestos in accordance with 40 CFR 763; understands the health implications and risks involved, including the illnesses possible from exposure to airborne asbestos fibers; understands the use and limits of the respiratory equipment to be used; and understands the results of monitoring of airborne quantities of asbestos as related to health and respiratory equipment as indicated in 29 CFR 1926.1101 on an initial and annual basis. Organize certificates by individual worker, not grouped by type of certification. Train personnel involved in the asbestos control work in accordance with United States Environmental Protection Agency

(USEPA) Asbestos Hazard Emergency Response Act (AHERA) training criteria or State training criteria whichever is more stringent. Document the training by providing: dates of training, training entity, course outline, names of instructors, and qualifications of instructors upon request by the Contracting Officer. Furnish each employee with respirator training and fit testing administered by the PQP as required by 29 CFR 1926.1101 and 29 CFR 1926.103. Fully cover engineering and other hazard control techniques and procedures. Asbestos workers must have a current State of South Dakota asbestos worker's license.

1.3.5 Permits, Licenses, and Notifications

Prior to the start of work, obtain necessary permits and licenses in conjunction with asbestos removal, encapsulation, hauling, and disposition, and furnish notification of such actions required by Federal, State, regional, and local authorities. Notify the State's environmental protection agency and the Contracting Officer in writing 10 working days prior to commencement of work in accordance with 40 CFR 61-SUBPART M. Notify the Contracting Officer and other appropriate Government agencies in writing 20 working days prior to the start of asbestos work as indicated in applicable laws, ordinances, criteria, rules, and regulations. Submit copies of all Notifications to the Contracting Officer. Notify the local fire department 3 days prior to removing fire-proofing material from the building including notice that the material contains asbestos.

1.3.6 Environment, Safety and Health Compliance

In addition to detailed requirements of this specification, comply with those applicable laws, ordinances, criteria, rules, and regulations of Federal, State, regional, and local authorities regarding handling, storing, transporting, and disposing of asbestos waste materials. Comply with the applicable requirements of the current issue of EM 385-1-1, 29 CFR 1926.1101, 40 CFR 61-SUBPART A, 40 CFR 61-SUBPART M, 40 CFR 763. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting the work. Where the requirements of this specification, applicable laws, rules, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirement as defined by the Government apply.

1.3.7 Respiratory Protection Program

Establish and implement a respirator program as required by 29 CFR 1926.1101, 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.

1.3.7.1 Respirator Program Records

Submit records of the respirator program as required by 29 CFR 1926.103, and 29 CFR 1926.1101.

1.3.7.2 Respirator Fit Testing

The Contractor's PQP must 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.

1.3.7.3 Respirator Selection and Use Requirements

Provide respirators, and ensure that they are used as required by 29 CFR 1926.1101 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 airborne asbestos fibers. 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 asbestos fiber concentrations to be encountered.

1.3.8 Asbestos Hazard Control Supervisor

The Contractor must be represented on site by a supervisor, trained using the model Contractor accreditation plan as indicated in the Federal statutes for all portions of the herein listed work.

1.3.9 Hazard Communication

Adhere to all parts of 29 CFR 1926.59 and provide the Contracting Officer with a copy of the Safety Data Sheets (SDS) for all materials brought to the site.

1.3.10 Asbestos Hazard Abatement Plan

Submit a detailed plan of the safety precautions such as lockout, tagout, tryout, fall protection, and confined space entry procedures and equipment and work procedures to be used in the removal and demolition of materials containing asbestos. The plan, not to be combined with other hazard abatement plans, must be prepared, signed, and sealed by the PQP. Provide a Table of Contents for each abatement submittal, which follows the sequence of requirements in the contract. The plan must include but not be limited to the precise personal protective equipment to be used including, but not limited to, respiratory protection, type of whole-body protection and if reusable coveralls are to be employed decontamination methods (operations and quality control plan), the location of asbestos control areas including clean and dirty areas, buffer zones, showers, storage areas, change rooms, removal method, interface of trades involved in the construction, sequencing of asbestos related work, disposal plan, type of wetting agent and asbestos sealer to be used, locations of local exhaust equipment, planned air monitoring strategies, and a detailed description of the method to be employed in order to control environmental pollution. The plan must also include (both fire and medical emergency) response plans and an Activity Hazard Analyses (AHAs) in accordance with EM 385-1-1. The Asbestos Hazard Abatement Plan must be approved in writing prior to starting any asbestos work. The Contractor, Asbestos Hazard Control Supervisor, CP and PQP must meet with the Contracting Officer prior to beginning work, to discuss in detail the Asbestos Hazard Abatement Plan, including work procedures and safety precautions. Once approved by the Contracting Officer, the plan will be enforced as if an addition to the specification. Any changes required in the specification

as a result of the plan must be identified specifically in the plan to allow for free discussion and approval by the Contracting Officer prior to starting work.

1.3.11 Testing Laboratory

Submit the name, address, and telephone number of each testing laboratory selected for the analysis, and reporting of airborne concentrations of asbestos fibers along with certification that each laboratory is American Industrial Hygiene Association (AIHA) accredited and that persons counting the samples have been judged proficient by current inclusion on the AIHA Asbestos Analysis Registry (AAR) and successful participation of the laboratory in the Proficiency Analytical Testing (PAT) Program. Where analysis to determine asbestos content in bulk materials or transmission electron microscopy is required, submit evidence that the laboratory is accredited by the National Institute of Science and Technology (NIST) under National Voluntary Laboratory Accreditation Program (NVLAP) for asbestos analysis. The testing laboratory firm must be independent of the asbestos contractor and must have no employee or employer relationship which could constitute a conflict of interest.

1.3.12 Landfill Approval

Submit written evidence that the landfill is approved for asbestos disposal by the U.S. Environmental Protection Agency, Region 8 and local regulatory agencies. Within three working days after delivery, submit detailed delivery tickets, prepared, signed, and dated by an agent of the landfill, certifying the amount of asbestos materials delivered to the landfill. Submit a copy of the waste shipment records within one day of the shipment leaving the project site.

1.3.13 Transporter Certification

Submit written evidence that the transporter is approved to transport asbestos waste in accordance with the DOT requirements of 49 CFR 171, 49 CFR 172 and 49 CFR 173 as well as registration requirements of 49 CFR 107 and all other State and local regulatory agency requirements.

1.3.14 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 1926.1101 and 29 CFR 1926.103 as prescribed by law. Submit certificates prior to the start of work but after the main abatement submittal.

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 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-03 Product Data

Amended Water

Safety Data Sheets (SDS) for All Materials

Encapsulants

Respirators

Local Exhaust Equipment

Pressure Differential Automatic Recording Instrument

Vacuums

Glovebags

SD-06 Test Reports

Air Sampling Results

Pressure Differential Recordings for Local Exhaust System

Clearance Sampling; G, RO

Asbestos Disposal Quantity Report; G, RO

SD-07 Certificates

Employee Training

Notifications

Respiratory Protection Program

Asbestos Hazard Abatement Plan; G, RO

Testing Laboratory; G, RO

Landfill Approval; G, RO

Delivery Tickets; G, RO

Waste Shipment Records; G, RO

Transporter Certification

Medical Certification

Private Qualified Person Documentation

Designated Competent Person

Worker's License

Contractor's License

Federal, State or Local Citations on Previous Projects

Encapsulants

Equipment Used to Contain Airborne Asbestos Fibers

Water Filtration Equipment

Vacuums

Ventilation Systems

SD-11 Closeout Submittals

Permits and Licenses

Notifications

Respirator Program Records

Protective Clothing Decontamination Quality Control Records

Protective Clothing Decontamination Facility Notification

Rental Equipment

1.5 QUALITY ASSURANCE

1.5.1 Private Qualified Person Documentation

Submit the name, address, and telephone number of the Private Qualified Person (PQP) selected to prepare the Asbestos Hazard Abatement Plan, direct monitoring and training, and documented evidence that the PQP has successfully completed training in and is accredited and where required is certified as, a Building Inspector, Contractor/Supervisor Abatement Worker, and Asbestos Project Designer as described by 40 CFR 763 and has successfully completed the National Institute of Occupational Safety and Health (NIOSH) 582 course "Sampling and Evaluating Airborne Asbestos Dust" or equivalent. The PQP and the asbestos contractor must not have an employee/employer relationship or financial relationship which could constitute a conflict of interest. The PQP must be a first tier subcontractor.

1.5.2 Designated Competent Person Documentation

The Designated Competent Person must be experienced in the administration and supervision of asbestos abatement projects including exposure assessment and monitoring, work practices, abatement methods, protective measures for personnel, setting up and inspecting asbestos abatement work areas, evaluating the integrity of containment barriers, placement and operation of local exhaust systems, ACM generated waste containment and disposal procedures, decontamination units installation and maintenance requirements, site safety and health requirements, notification of other employees onsite. The Designated Competent Person must be on-site at all times when asbestos abatement activities are underway.Submit training certification and a current State of South Dakota Asbestos Contractor's and Supervisor's License. Submit evidence that the Designated Competent Person has a minimum of 2 years of on-the-job asbestos abatement experience relevant to OSHA designated competent person requirements. The Designated Competent Person must be a first tier subcontractor.

1.5.3 Worker's License

Submit documentation that workers meet the requirements of 29 CFR 1926.1101,

40 CFR 61-SUBPART M and have a current State of South Dakota Asbestos Workers License.

1.5.4 Contractor's License

Submit a copy of the asbestos contractor's license issued by the State of South Dakota. Submit the following certification along with the license: "I certify that the personnel I am responsible for during the course of this project fully understand the contents of 29 CFR 1926.1101, 40 CFR 61-SUBPART MEM 385-1-1, and the Federal, State and local requirements for those asbestos abatement activities that they will be involved in." This certification statement must be signed by the Company's President or Chief Executive.

1.5.5 Air Sampling Results

Complete fiber counting and provide results to the PQP for review within 16 hours of the "time off" of the sample pump. Notify the Contracting Officer immediately of any airborne levels of asbestos fibers in excess of the acceptable limits. Submit sampling results to the Contracting Officer and the affected Contractor employees where required by law within three working days, signed by the testing laboratory employee performing air sampling, the employee that analyzed the sample, and the PQP. Notify the Contractor and the Contracting Officer immediately of any variance in the pressure differential which could cause adjacent unsealed areas to have asbestos fiber concentrations in excess of 0.01 fibers per cubic centimeter or background whichever is higher. In no circumstance must levels exceed 0.1 fibers per cubic centimeter.

1.5.6 Pressure Differential Recordings for Local Exhaust System

Provide a local exhaust system that creates a negative pressure of at least 0.02 inches of water relative to the pressure external to the enclosure and operate it continuously, 24-hours a day, until the temporary enclosure of the asbestos control area is removed. Submit pressure differential recordings for each work day to the PQP for review and to the Contracting Officer within 24-hours from the end of each work day.

1.5.7 Protective Clothing Decontamination Quality Control Records

Provide all records that document quality control for the decontamination of reusable outer protective clothing.

1.5.8 Protective Clothing Decontamination Facility Notification

Submit written evidence that persons who decontaminate, store, or transport asbestos contaminated clothing used in the performance of this contract were duly notified in accordance with 29 CFR 1926.1101.

1.5.9 Federal, State or Local Citations on Previous Projects

Submit a statement, signed by an officer of the company, containing a record of any citations issued by Federal, State or local regulatory agencies relating to asbestos activities within the last 5 years (including projects, dates, and resolutions); a list of penalties incurred through non-compliance with asbestos project specifications, including liquidated damages, overruns in scheduled time limitations and resolutions; and situations in which an asbestos-related contract has been terminated (including projects, dates, and reasons for terminations). If

there are none, a negative declaration signed by an officer of the company must be provided.

1.5.10 Preconstruction Conference

Conduct a safety preconstruction conference to discuss the details of the Asbestos Hazard Abatement Plan, Accident Prevention Plan (APP) including the AHAs required. The safety preconstruction conference must include the Contractor and their Designated Competent Person, 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.

1.6 SECURITY

A log book must be kept documenting entry into and out of the regulated area. Entry into regulated areas must only be by personnel authorized by the Contractor and the Contracting Officer. Personnel authorized to enter regulated areas must be trained, medically evaluated, and wear the required personal protective equipment.

1.7 EQUIPMENT

1.7.1 Rental Equipment

Provide a copy of the written notification to the rental company concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Encapsulants must conform to current USEPA requirements, contain no toxic or hazardous substances as defined in 29 CFR 1926.59, and conform to the following performance requirements.

2.1.1 Lock-down Encapsulant

| Requirement | Test Standard |
|---|---|
| Flame Spread - 25, Smoke Emission - 50 | ASTM E84 |
| Life Expectancy - 20 years | ASTM C732 Accelerated Aging Test |
| Permeability - Minimum 0.4 perms | ASTM E96/E96M |
| Fire Resistance - Negligible affect on fire resistance rating over 3-hour test (Tested with fireproofing over encapsulant applied directly to steel member) | ASTM E119 |

| Requirement | Test Standard |
|---|---|
| Bond Strength: 100 pounds of force/foot | ASTM E736/E736M |
| (Tests compatibility with cementitious and fibrous fireproofing) | |

2.2 DUCT TAPE

Industrial grade duct tape of appropriate widths suitable for bonding sheet plastic and disposal container.

2.3 DISPOSAL CONTAINERS

Leak-tight (defined as solids, liquids, or dust that cannot escape or spill out) disposal containers must be provided for ACM wastes as required by 29 CFR 1926.1101. Disposal containers can be in the form of:

a. Disposal Bags

b. Fiberboard Drums

c. Cardboard Boxes

d. Lined roll off containers

2.4 SHEET PLASTIC

Sheet plastic must be polyethylene of 6 mil minimum thickness and must be provided in the largest sheet size necessary to minimize seams. Film must be clear and conform to ASTM D4397, except as specified below

2.4.1 Flame Resistant

Where a potential for fire exists, flame-resistant sheets must be provided. Film must be frosted or black and must conform to the requirements of NFPA 701.

2.4.2 Reinforced

Reinforced sheets must be provided where high skin strength is required, such as where it constitutes the only barrier between the regulated area and the outdoor environment. The sheet stock must consist of translucent, nylon-reinforced or woven-polyethylene thread laminated between 2 layers of polyethylene film. Film must meet flame resistant standards of NFPA 701.

2.5 MASTIC REMOVING SOLVENT

Mastic removing solvent must be nonflammable and must not contain methylene chloride, glycol ether, or halogenated hydrocarbons. Solvents used onsite must have a flash point greater than 140 degrees F.

2.6 LEAK-TIGHT WRAPPING

Two layers of 6 mil minimum thick polyethylene sheet stock must be used for the containment of removed asbestos-containing components or materials

such as large tanks, boilers, insulated pipe segments and other materials. Upon placement of the ACM component or material, each layer must be individually leak-tight sealed with duct tape.

2.7 VIEWING INSPECTION WINDOW

Where feasible, a minimum of one clear, 1/8 inch thick, acrylic sheet, 18 by 24 inches, must be installed as a viewing inspection window at eye level on a wall in each containment enclosure. The windows must be sealed leak-tight with industrial grade duct tape.

2.8 WETTING AGENTS

Removal encapsulant (a penetrating encapsulant) must be provided when conducting removal abatement activities that require a longer removal time or are subject to rapid evaporation of amended water. The removal encapsulant must be capable of wetting the ACM and retarding fiber release during disturbance of the ACM greater than or equal to that provided by amended water. Performance requirements for penetrating encapsulants are specified in paragraph ENCAPSULANTS above.

PART 3 EXECUTION

3.1 EQUIPMENT

Provide the Contracting Officer or the Contracting Officer's Representative, with at least two complete sets of personal protective equipment including decontaminating reusable coveralls as required for entry to and inspection of the asbestos control area. Provide equivalent training to the Contracting Officer or a designated representative as provided to Contractor employees in the use of the required personal protective equipment. Provide manufacturer's certificate of compliance for all equipment used to contain airborne asbestos fibers.

3.1.1 Air Monitoring Equipment

The Contractor's PQP must approve air monitoring equipment. The equipment must include, but must not be limited to:

a. High-volume sampling pumps that can be calibrated and operated at a constant airflow up to 16 liters per minute.

b. Low-volume, battery powered, body-attachable, portable personal pumps that can be calibrated to a constant airflow up to approximately 3.5 liters per minute, and a self-contained rechargeable power pack capable of sustaining the calibrated flow rate for a minimum of 10 hours. The pumps must also be equipped with an automatic flow control unit which must maintain a constant flow, even as filter resistance increases due to accumulation of fiber and debris on the filter surface.

c. Single use standard 25 mm diameter cassette, open face, 0.8 micron pore size, mixed cellulose ester membrane filters and cassettes with 50 mm electrically conductive extension cowl, and shrink bands for personal air sampling.

d. Single use standard 25 mm diameter cassette, open face, 0.45 micron pore size, mixed cellulose ester membrane filters and cassettes with 50 mm electrically conductive cowl, and shrink bands when conducting

environmental area sampling using NIOSH NMAM Methods 7400 and 7402, (and the transmission electric microscopy method specified at 40 CFR 763 if required).

e. A flow calibrator capable of calibration to within plus or minus 2 percent of reading over a temperature range of minus 4 to plus 140 degrees F and traceable to a NIST primary standard.

3.1.2 Respirators

Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

3.1.2.1 Respirators for Handling Asbestos

Provide personnel engaged in pre-cleaning, cleanup, handling, removal and or demolition of asbestos materials with respiratory protection as indicated in 29 CFR 1926.1101 and 29 CFR 1926.103. Breathing air must comply with CGA G-7.

3.1.3 Exterior Whole Body Protection

3.1.3.1 Outer Protective Clothing

Provide personnel exposed to asbestos with disposable "non-breathable," or reusable "non-breathable" whole body outer protective clothing, head coverings, gloves, and foot coverings. Provide disposable plastic or rubber gloves to protect hands. Cloth gloves may be worn inside the plastic or rubber gloves for comfort, but must not be used alone. Make sleeves secure at the wrists, make foot coverings secure at the ankles, and make clothing secure at the neck by the use of tape. Reusable whole body outer protective clothing must be either disposed of as asbestos contaminated waste upon exiting from the asbestos regulated work area or be properly decontaminated.

3.1.3.2 Work Clothing

Provide cloth work clothes for wear under the outer protective clothing and foot coverings and either dispose of or properly decontaminate them after each use.

3.1.3.3 Personal Decontamination Unit

Provide a temporary, negative pressure unit with a separate decontamination locker room and clean locker room with a shower that complies with 29 CFR 1926.51(f)(4)(ii) through (V) in between for personnel required to wear whole body protective clothing. Provide two separate lockers for each asbestos worker, one in each locker room. Keep street clothing and street shoes in the clean locker. HEPA vacuum and remove asbestos contaminated disposable protective clothing while still wearing respirators at the boundary of the asbestos work area and seal in impermeable bags or containers for disposal. HEPA vacuum and remove asbestos contaminated reusable protective clothing while still wearing respirators at the boundary of the asbestos work area, seal in two impermeable bags, label outer bag as asbestos contaminated waste, and transport for decontamination. Do not wear work clothing between home and work. Locate showers between the decontamination locker room and the clean locker room and require that all employees shower before changing

into street clothes. Collect used shower water and filter with approved water filtration equipment to remove asbestos contamination. Wastewater filters must be installed in series with the first stage pore size 20 microns and the second stage pore size of 5 microns. Dispose of filters and residue as asbestos waste. Discharge clean water to the sanitary system. Dispose of asbestos contaminated work clothing as asbestos contaminated waste or properly decontaminate as specified in the Contractor's Asbestos Hazard Abatement Plan. Keep the floor of the decontamination unit's clean room dry and clean at all times. Proper housekeeping and hygiene requirements must be maintained. Provide soap and towels for showering, washing and drying. Cloth towels provided must be disposed of as ACM waste or must be laundered in accordance with 29 CFR 1926.1101. Physically attach the decontamination units to the asbestos control area. Construct both a personnel decontamination unit and an equipment decontamination unit onto and integral with each asbestos control area.

3.1.3.4 Decontamination of Reusable Outer Protective Clothing

When reusable outer protective clothing is used, transport the double bagged clothing to a previously notified commercial/industrial decontamination facility for decontamination. Perform non-destructive testing to determine the effectiveness of asbestos decontamination. If representative sampling is used, ensure the statistical validity of the sampling results. If representative sampling is used, reject any entire batch in which any of the pieces exceed 40 fibers per square millimeter. Inspect reusable protective clothing prior to use to ensure that it will provide adequate protection and is not or is not about to become ripped, torn, deteriorated, or damaged, and that it is not visibly contaminated. Notify, in writing, all personnel involved in the decontamination of reusable outer protective clothing as indicated in 29 CFR 1926.1101.

3.1.3.5 Eye Protection

Provide eye protection that complies with ANSI/ISEA Z87.1 when operations present a potential eye injury hazard. Provide goggles to personnel engaged in asbestos abatement operations when the use of a full face respirator is not required.

3.1.4 Regulated Areas

All Class I, II, and III asbestos work must be conducted within regulated areas. The regulated area must be demarcated to minimize the number of persons within the area and to protect persons outside the area from exposure to airborne asbestos. Control access to regulated areas, ensure that only authorized personnel enter, and verify that Contractor required medical surveillance, training and respiratory protection program requirements are met prior to allowing entrance.

3.1.5 Load-out Unit

Provide a temporary load-out unit that is adjacent and connected to the regulated area and access tunnel. Attach the load-out unit in a leak-tight manner to each regulated area.

3.1.6 Warning Signs and Labels

Provide bilingual warning signs printed in English and Spanish at all approaches to asbestos control areas. Locate signs at such a distance

that personnel may read the sign and take the necessary protective steps required before entering the area. Provide labels and affix to all asbestos materials, scrap, waste, debris, and other products contaminated with asbestos. Containers with preprinted warning labels conforming to the requirements are acceptable

3.1.6.1 Warning Sign

Provide vertical format conforming to 29 CFR 1926.200, and 29 CFR 1926.1101 minimum 20 by 14 inches displaying the following legend in the lower panel:

| Legend | Notation |
|---|---|
| DANGER | one inch Sans Serif Gothic or Block |
| ASBESTOS | one inch Sans Serif Gothic or Block |
| MAY CAUSE CANCER | one inch Sans Serif Gothic or Block |
| CAUSES DAMAGE TO LUNGS | 1/4 inch Sans Serif Gothic or Block |
| AUTHORIZED PERSONNEL ONLY | 1/4 inch Sans Serif Gothic or Block |
| WEAR RESPIRATORY PROTECTION AND PROTECTIVE CLOTHING IN THIS AREA | 1/4 inch Sans Serif Gothic or Block |

Spacing between lines must be at least equal to the height of the upper of any two lines.

3.1.6.2 Warning Labels

Provide labels conforming to 29 CFR 1926.1101 of sufficient size to be clearly legible, displaying the following legend:

| |
|---|
| DANGER |
| CONTAINS ASBESTOS FIBERS |
| MAY CAUSE CANCER |
| CAUSES DAMAGE TO LUNGS |
| DO NOT BREATHE DUST AVOID CREATING DUST |

3.1.7 Local Exhaust System

Provide a local exhaust system in the asbestos control area in accordance with ASSP Z9.2 and 29 CFR 1926.1101 that will provide at least four air changes per hour inside of the negative pressure enclosure. Local exhaust equipment must be operated 24-hours per day, until the asbestos control area is removed and must be leak proof to the filter and equipped with HEPA filters. Maintain a minimum pressure differential in the control area of minus 0.02 inch of water column relative to adjacent, unsealed areas. Provide continuous 24-hour per day monitoring of the pressure differential with a pressure differential automatic recording instrument.

The building ventilation system must not be used as the local exhaust system for the asbestos control area. Filters on exhaust equipment must conform to ASSP Z9.2 and UL 586. Terminate the local exhaust system out of doors and remote from any public access or ventilation system intakes.

3.1.8 Tools

Vacuums must be leak proof to the filter and equipped with HEPA filters. Filters on vacuums must conform to ASSP Z9.2 and UL 586. Do not use power tools to remove asbestos containing materials unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation systems. Remove all residual asbestos from reusable tools prior to storage or reuse. Reusable tools must be thoroughly decontaminated prior to being removed from the regulated areas.

3.1.9 Rental Equipment

If rental equipment is to be used, furnish written notification to the rental agency concerning the intended use of the equipment and the possibility of asbestos contamination of the equipment.

3.1.10 Glovebags

Submit written manufacturers proof that glovebags will not break down under expected temperatures and conditions.

3.1.11 Single Stage Decontamination Area

A decontamination area (equipment room/area) must be provided for Class I work involving less than 25 feet or 10 square feet of TSI or surfacing ACM, and for Class II and Class III asbestos work operations where exposures exceed the PELs or where there is no negative exposure assessment. The equipment room or area must be adjacent to the regulated area for the decontamination of employees, material, and their equipment which could be contaminated with asbestos. The area must be covered by an impermeable drop cloth on the floor or horizontal working surface. The area must be of sufficient size to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area.

3.1.12 Decontamination Area Exit Procedures

Ensure that the following procedures are followed:

a. Before leaving the regulated area, remove all gross contamination and debris from work clothing using a HEPA vacuum.

b. Employees must remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers for disposal or laundering.

c. Employees must not remove their respirators until showering.

d. Employees must shower prior to entering the clean room. If a shower has not been located between the equipment room and the clean room or the work is performed outdoors, ensure that employees engaged in Class I asbestos jobs: a) Remove asbestos contamination from their work suits in the equipment room or decontamination area using a HEPA vacuum before proceeding to a shower that is not adjacent to the work

area; or b) Remove their contaminated work suits in the equipment room, without cleaning worksuits, and proceed to a shower that is not adjacent to the work area.

3.2 WORK PROCEDURE

Perform asbestos related work in accordance with 29 CFR 1926.1101, 40 CFR 61-SUBPART M, and as specified herein. Use wet or if given prior EPA approval, dry removal procedures and negative pressure enclosure techniques. Wear and utilize protective clothing and equipment as specified herein. No eating, smoking, drinking, chewing gum, tobacco, or applying cosmeticsis permitted in the asbestos work or control areas. Personnel of other trades not engaged in the removal and demolition of asbestos containing material must not be exposed at any time to airborne concentrations of asbestos unless all the personnel protection and training provisions of this specification are complied with by the trade personnel. Shut down the building heating, ventilating, and air conditioning system, cap the openings to the system, and provide temporary heating, and ventilation, and air conditioning prior to the commencement of asbestos work. Power to the regulated area must be locked-out and tagged in accordance with 29 CFR 1910.147. Disconnect electrical service when wet removal is performed and provide temporary electrical service with verifiable ground fault circuit interrupter (GFCI) protection prior to the use of any water. All electrical work must be performed by a licensed electrician. Stop abatement work in the regulated area immediately when the airborne total fiber concentration: (1) equals or exceeds 0.01 f/cc, or the pre-abatement concentration, whichever is greater, outside the regulated area; or (2) equals or exceeds 1.0 f/cc inside the regulated area. Correct the condition to the satisfaction of the Contracting Officer, including visual inspection and air sampling. Work must resume only upon notification by the Contracting Officer. Corrective actions must be documented. If an asbestos fiber release or spill occurs outside of the asbestos control area, stop work immediately, correct the condition to the satisfaction of the Contracting Officer including clearance sampling, prior to resumption of work.

3.2.1 Building Ventilation System and Critical Barriers

Building ventilation system supply and return air ducts in a regulated area must be isolated by airtight seals to prevent the spread of contamination throughout the system. The airtight seals must consist of 2 layers of polyethylene. Edges to wall, ceiling and floor surfaces must be sealed with industrial grade duct tape.

a. A Competent Person must supervise the work.

b. For indoor work, critical barriers must be placed over all openings to the regulated area.

c. Impermeable dropcloths must be placed on surfaces beneath all removal activity.

3.2.2 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent work. Where such work is damaged or contaminated as verified by the Contracting Officer using visual inspection or sample analysis, it must be restored to its original condition or decontaminated by the Contractor at no expense to the Government as deemed appropriate by the Contracting Officer. This

includes inadvertent spill of dirt, dust, or debris in which it is reasonable to conclude that asbestos may exist. When these spills occur, stop work immediately. Then clean up the spill. When satisfactory visual inspection and air sampling results are obtained from the PQP work may proceed at the discretion of the Contracting Officer.

3.2.3 Furnishings

Furniture and equipment will remain in the building. Cover and seal furnishings with 6-mil plastic sheet or remove from the work area and store in a location on site approved by the Contracting Officer.

3.2.4 Precleaning

Wet wipe and HEPA vacuum all surfaces potentially contaminated with asbestos prior to establishment of an enclosure.

3.2.5 Asbestos Control Area Requirements

3.2.5.1 Negative Pressure Enclosure

Removal of gypsum wallboard/joint compound require the use of a negative pressure enclosure. Block and seal openings in areas where the release of airborne asbestos fibers can be expected. Establish an asbestos negative pressure enclosure with the use of curtains, portable partitions, or other enclosures in order to prevent the escape of asbestos fibers from the contaminated asbestos work area. Negative pressure enclosure development must include protective covering of uncontaminated walls, and ceilings with a continuous membrane of two layers of minimum 6-mil plastic sheet sealed with tape to prevent water or other damage. Provide two layers of 6-mil plastic sheet over floors and extend a minimum of 12 inches up walls. Seal all joints with tape. Provide local exhaust system in the asbestos control area. Openings will be allowed in enclosures of asbestos control areas for personnel and equipment entry and exit, the supply and exhaust of air for the local exhaust system and the removal of properly containerized asbestos containing materials. Replace local exhaust system filters as required to maintain the efficiency of the system.

3.2.5.2 Glovebag

If the construction of a negative pressure enclosure is infeasible for the removal of asbestos containing materials, use alternate techniques as indicated in 29 CFR 1926.1101. Establish designated limits for the asbestos regulated area with the use of rope or other continuous barriers, and maintain all other requirements for asbestos control areas. The PQP must conduct personal samples of each worker engaged in asbestos handling (removal, disposal, transport and other associated work) throughout the duration of the project. If the quantity of airborne asbestos fibers monitored at the breathing zone of the workers at any time exceeds background or 0.01 fibers per cubic centimeter whichever is greater, stop work, evacuate personnel in adjacent areas or provide personnel with approved protective equipment at the discretion of the Contracting Officer. This sampling may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those obtained by the Contractor, the Government will determine which results predominate. If adjacent areas are contaminated as determined by the Contracting Officer, clean the contaminated areas, monitor, and visually inspect the area as specified herein.

3.2.5.3 Regulated Area for Class II Removal

Removal of asbestos containing floor tile/mastic and asbestos containing piping are Class II removal activities. Establish designated limits for the asbestos regulated work area with the use of red barrier tape; install critical barriers, splash guards and signs, and maintain all other requirements for asbestos control area except local exhaust. Place impermeable dropcloths on surfaces beneath removal activity extending out 3 feet in all directions. A detached decontamination system may be used. Conduct area monitoring of airborne fibers during the work shift at the designated limits of the asbestos work area and conduct personal samples of each worker engaged in the work. If workers the airborne fiber concentration of the workers or designated limits at any time exceeds background or 0.01 fibers per cubic centimeter, whichever is greater, stop work immediately and correct the situation.

3.2.6 Removal Procedures

Wet asbestos material with a fine spray of amended water during removal, cutting, or other handling so as to reduce the emission of airborne fibers. Remove material and immediately place in 6 mil plastic disposal bags. Remove asbestos containing material in a gradual manner, with continuous application of the amended water or wetting agent in such a manner that no asbestos material is disturbed prior to being adequately wetted. Where unusual circumstances prohibit the use of 6 mil plastic bags, submit an alternate proposal for containment of asbestos fibers to the Contracting Officer for approval. For example, in the case where both piping and insulation are to be removed, the Contractor may elect to wet the insulation, wrap the pipes and insulation in plastic and remove the pipe by sections. Containerize asbestos containing material while wet. Do not allow asbestos material to accumulate or become dry. Lower and otherwise handle asbestos containing material as indicated in 40 CFR 61-SUBPART M.

3.2.6.1 Sealing Contaminated Items Designated for Disposal

Remove contaminated architectural, mechanical, and electrical appurtenances such as venetian blinds, full-height partitions, carpeting, duct work, pipes and fittings, radiators, light fixtures, conduit, panels, and other contaminated items designated for removal by completely coating the items with an asbestos lock-down encapsulant at the demolition site before removing the items from the asbestos control area. These items need not be vacuumed. The asbestos lock-down encapsulant must be tinted a contrasting color and spray-applied by airless method. Thoroughness of sealing operation must be visually gauged by the extent of colored coating on exposed surfaces. Lock-down encapsulants must comply with the performance requirements specified herein.

3.2.7 Methods of Compliance

3.2.7.1 Mandated Practices

The specific abatement techniques and items identified must be detailed in the Contractor's AHAP. Use the following engineering controls and work practices in all operations, regardless of the levels of exposure:

a. Vacuum cleaners equipped with HEPA filters.

b. Wet methods or wetting agents except where it can be demonstrated that the use of wet methods is unfeasible due to the creation of electrical hazards, equipment malfunction, and in roofing.

c. Prompt clean-up and disposal.

d. Inspection and repair of polyethylene.

e. Cleaning of equipment and surfaces of containers prior to removing them from the equipment room or area.

3.2.7.2 Control Methods

Use the following control methods:

a. Local exhaust ventilation equipped with HEPA filter;

b. Enclosure or isolation of processes producing asbestos dust;

c. Where the feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the PELs, use them to reduce employee exposure to the lowest levels attainable and must supplement them by the use of respiratory protection.

3.2.7.3 Unacceptable Practices

The following work practices must not be used:

a. High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filtered exhaust air.

b. Compressed air used to remove asbestos containing materials, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.

c. Dry sweeping, shoveling, or other dry clean up.

d. Employee rotation as a means of reducing employee exposure to asbestos.

3.2.8 Class I Work Procedures

In addition to requirements of paragraphs MANDATED PRACTICES and CONTROL METHODS, the following engineering controls and work practices must be used:

a. A Competent Person must supervise the installation and operation of the control methods.

b. For jobs involving the removal of more than 25 feet or 10 square feet of TSI or surfacing material, place critical barriers over all openings to the regulated area.

c. HVAC systems must be isolated in the regulated area by sealing with a double layer of plastic or air-tight rigid covers.

d. Impermeable dropcloths (6 mil or greater thickness) must be placed on surfaces beneath all removal activity.

e. Where a negative exposure assessment has not been provided or where exposure monitoring shows the PEL was exceeded, the regulated area must be ventilated with a HEPA unit and employees must use PPE.

3.2.9 Specific Control Methods for Class I Work

Use Class I work procedures, control methods and removal methods for the following ACM:

a. Gypsum Wallboard and Joint Compound

3.2.9.1 Negative Pressure Enclosure (NPE) System

The system must provide at least four air changes per hour inside the containment. The local exhaust unit equipment must be operated 24-hours per day until the containment is removed. The NPE must be smoke tested for leaks at the beginning of each shift and be sufficient to maintain a minimum pressure differential of minus 0.02 inch of water column relative to adjacent, unsealed areas. Pressure differential must be monitored continuously, 24-hours per day, with an automatic manometric recording instrument and Records must be provided daily on the same day collected to the Contracting Officer. The Contracting Officer must be notified immediately if the pressure differential falls below the prescribed minimum. The building ventilation system must not be used as the local exhaust system for the regulated area. The NPE must terminate outdoors unless an alternate arrangement is allowed by the Contracting Officer. All filters used must be new at the beginning of the project and must be periodically changed as necessary and disposed of as ACM waste.

3.2.9.2 Glovebag Systems

Glovebags must be used without modification, smoke-tested for leaks, and completely cover the circumference of pipe or other structures where the work is to be done. Glovebags must be used only once and must not be moved. Glovebags must not be used on surfaces that have temperatures exceeding 150 degrees F. Prior to disposal, glovebags must be collapsed using a HEPA vacuum. Before beginning the operation, loose and friable material adjacent to the glovebag operation must be wrapped and sealed in 2 layers of plastic or otherwise rendered intact. At least two persons must perform glovebag removal. Asbestos regulated work areas must be established for glovebag abatement. Designated boundary limits for the asbestos work must be established with rope or other continuous barriers and all other requirements for asbestos control areas must be maintained, including area signage and boundary warning tape.

a. Attach HEPA vacuum systems to the bag to prevent collapse during removal of ACM.

b. The negative pressure glove boxes must be fitted with gloved apertures and a bagging outlet and constructed with rigid sides from metal or other material which can withstand the weight of the ACM and water used during removal. A negative pressure must be created in the system using a HEPA filtration system. The box must be smoke tested for leaks prior to each use.

3.2.9.3 Mini-Enclosure

Single bulkhead containment, Double bulkhead containment, or Mini-containment (small walk-in enclosure) to accommodate no more than two

persons, may be used if the disturbance or removal can be completely contained by the enclosure. The mini-enclosure must be inspected for leaks and smoke tested before each use. Air movement must be directed away from the employee's breathing zone within the mini-enclosure.

3.2.9.4 Wrap and Cut Operation

Prior to cutting pipe, the asbestos-containing insulation must be wrapped with polyethylene and securely sealed with duct tape to prevent asbestos becoming airborne as a result of the cutting process. The following steps must be taken: install glovebag, strip back sections to be cut 6 inches from point of cut, and cut pipe into manageable sections.

3.2.9.5 Class I Removal Method

Class I ACM must be removed using a control method described above. Prepare work area as previously specified. Establish designated limits for the asbestos regulated work area with the use of red barrier tape, critical barriers, signs, and maintain all other requirements for asbestos control area. Spread one layer of 6-mil seamless plastic sheeting on the floor below the work area. Cut manageable sections of gypsum wallboard and joint compound and immediately place into a 6-mil minimum thickness disposal bag or other approved container. Make every effort to keep the material from falling to the floor of the work area. Use a wire brush and wet clean to remove residual material from studs. Continue wet cleaning until the surface is clean of visible material and encapsulate stud walls.
Bag all asbestos debris which has fallen to the floor as asbestos-containing debris. Place all debris in plastic disposal bags of 6-mil minimum thickness. Once the material is in the disposal bag, apply additional water as needed to achieve "adequately wet" conditions for NESHAP compliance. Place bagged asbestos waste under negative pressure with the use of a HEPA vacuum, goose neck and duck tape to seal the bag, wash to remove any visible contamination and place into a second 6-mil minimum thickness disposal bag. Containerize asbestos containing waste while wet. Lower and otherwise handle asbestos containing materials as indicated in 40 CFR 61-SUBPART M. Conduct area monitoring of airborne fibers during the work shift at the designated limits of the asbestos work area and conduct personal samples of each worker engaged in the work. If the quantity of airborne asbestos fibers monitored at the breathing zone of the workers or the designated limits at any time exceeds background or 0.01 fibers per cubic centimeter, whichever is greater, stop work, and immediately correct the situation.

3.2.10 Class II Work Procedures

In addition to the requirements of paragraphs MANDATED PRACTICES and CONTROL METHODS, the following engineering controls and work practices must be used:

a. A Competent Person must supervise the work.

b. For indoor work, critical barriers must be placed over all openings to the regulated area.

c. Impermeable dropcloths must be placed on surfaces beneath all removal activity.

### 3.2.11 Specific Control Methods for Class II Work

#### 3.2.11.1 Vinyl and Asphaltic Flooring Materials

Establish designated limits for the asbestos regulated work area with the use of red barrier tape, critical barriers, signs, and maintain all other requirements for asbestos control area except local exhaust. A detached decontamination system may be used. When removing vinyl floor tile and mastic which contains ACM, use the following practices. Remove floor tile and mastic using adequately wet methods. Remove floor tiles intact (if possible). Do not sand flooring or its backing. Scrape residual adhesive and backing using wet methods. Mechanical chipping is prohibited unless performed in a negative pressure enclosure. Dry sweeping is prohibited. Use vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) to clean floors. Place debris into a 6-mil minimum thickness disposal bag or other approved container. Once the material is in the disposal bag, apply additional water as needed to achieve "adequately wet" conditions for NESHAP compliance. Place bagged asbestos waste under negative pressure with the use of a HEPA vacuum, goose neck and duck tape to seal the bag, wash to remove any visible contamination and place into a second 6-mil minimum thickness disposal bag. Containerize asbestos containing waste while wet. Lower and otherwise handle asbestos containing materials as indicated in 40 CFR 61-SUBPART M. Conduct area monitoring of airborne fibers during the work shift at the designated limits of the asbestos work area and conduct personal samples of each worker engaged in the work. If workers the airborne fiber concentration of the workers or designated limits at any time exceeds background or 0.01 fibers per cubic centimeter, whichever is greater, stop work immediately and correct the situation.

#### 3.2.11.2 Suspect Fire Doors

Establish designated limits for the asbestos regulated work area with the use of red barrier tape, critical barriers, signs, and maintain all other requirements for asbestos control area except local exhaust. A detached decontamination system may be used. Spread 6-mil plastic sheeting on the ground beneath the work area and around the perimeter of the work area extending out in all directions. Remove door intact from hinges and wrap with 6-mil plastic sheeting. Inspect the interior areas of the door to determine if ACM is present. If ACM is not present the door may be disposed of as general construction debris. If ACM is present place whole door in enclosed container for disposal. Conduct area monitoring of airborne fibers during the work shift at the designated limits of the asbestos work area and conduct personal samples of each worker engaged in the work. If the airborne fiber concentration of the workers or designated limits at any time exceeds background or 0.01 fibers per cubic centimeter, whichever is greater, stop work immediately and correct the situation.

### 3.2.12 Encapsulation Procedures

#### 3.2.12.1 Large-Scale Application

Apply lockdown encapsulant following manufacturer recommendations. Keep the encapsulant material stirred to prevent settling. Keep a clean work area. Change pre-filters in the ventilation equipment as soon as they appear clogged by encapsulant aerosol or pressure differential drops below 0.02 Hg.

3.2.13 Air Sampling

Perform sampling of airborne concentrations of asbestos fibers in accordance with 29 CFR 1926.1101, the Contractor's air monitoring plan and as specified herein. Sampling performed in accordance with 29 CFR 1926.1101 must be performed by the PQP. Sampling performed for environmental and quality control reasons must be performed by the PQP. Unless otherwise specified, use NIOSH Method 7400 for sampling and analysis. Monitoring may be duplicated by the Government at the discretion of the Contracting Officer. If the air sampling results obtained by the Government differ from those results obtained by the Contractor, the Government will determine which results predominate. Results of breathing zone samples must be posted at the job site and made available to the Contracting Officer. Submit all documentation regarding initial exposure assessments, negative exposure assessments, and air-monitoring results.

3.2.13.1 Sampling Prior to Asbestos Work

Provide area air sampling and establish the baseline one day prior to the masking and sealing operations for each demolition site. Establish the background by performing area sampling in similar but uncontaminated sites in the building.

3.2.13.2 Sampling During Asbestos Work

The PQP must provide personal and area sampling as indicated in 29 CFR 1926.1101 and governing environmental regulations. Breathing zone samples must be taken for at least 25 percent of the workers in each shift, or a minimum of two, whichever is greater. Air sample fiber counting must be completed and results provided within 24-hours (breathing zone samples), and after completion of a sampling period. In addition, provided the same type of work is being performed, provide area sampling at least once every work shift close to the work inside the enclosure, outside the clean room entrance to the enclosure, and at the exhaust opening of the local exhaust system. If sampling outside the enclosure shows airborne levels have exceeded background or 0.01 fibers per cubic centimeter, whichever is greater, stop all work, correct the condition(s) causing the increase, and notify the Contracting Officer immediately. Where alternate methods are used, perform personal and area air sampling at locations and frequencies that will accurately characterize the evolving airborne asbestos levels. The written results must be signed by testing laboratory analyst, testing laboratory principal and the Contractor's PQP. The air sampling results must be documented on a Contractor's daily air monitoring log.

3.2.13.3 Final Clearance Requirements, NIOSH PCM Method

For PCM sampling and analysis using NIOSH NMAM Method 7400, the fiber concentration inside the abated regulated area, for each airborne sample, must be less than 0.01 f/cc. The abatement inside the regulated area is considered complete when every PCM final clearance sample is below the clearance limit. If any sample result is greater than 0.01 total f/cc, the asbestos fiber concentration (asbestos f/cc) must be confirmed from that same filter using NIOSH NMAM Method 7402 (TEM) at Contractor's expense. If any confirmation sample result is greater than 0.01 asbestos f/cc, abatement is incomplete and cleaning must be repeated at the Contractor's expense. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria must be done

at the Contractor's expense.

3.2.13.4 Final Clearance Requirements, EPA TEM Method

For EPA TEM sampling and analysis, using the EPA Method specified in 40 CFR 763, abatement inside the regulated area is considered complete when the arithmetic mean asbestos concentration of the five inside samples is less than or equal to 70 structures per square millimeter (70 S/mm). When the arithmetic mean is greater than 70 S/mm, the three blank samples must be analyzed. If the three blank samples are greater than 70 S/mm, resampling must be done. If less than 70 S/mm, the five outside samples must be analyzed and a Z-test analysis performed. When the Z-test results are less than 1.65, the decontamination must be considered complete. If the Z-test results are more than 1.65, the abatement is incomplete and cleaning must be repeated. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria must be done at the Contractor's expense.

3.2.13.5 Sampling After Final Clean-Up (Clearance Sampling)

Provide area sampling of asbestos fibers using aggressive air sampling techniques as defined in the EPA 560/5-85-024 and establish an airborne asbestos concentration of less than 0.01 fibers per cubic centimeter after final clean-up but before removal of the enclosure or the asbestos work control area. After final cleanup and the asbestos control area is dry but prior to clearance sampling, the PQP must perform a visual inspection in accordance with ASTM E1368 to ensure that the asbestos control and work area is free of any accumulations of dirt, dust, or debris. Prepare a written report signed and dated by the PQP documenting that the asbestos control area is free of dust, dirt, and debris and all waste has been removed. Use transmission electron microscopy (TEM) to analyze clearance samples and report the results in accordance with current NIOSH criteria. The asbestos fiber counts from these samples must be less than 0.01 fibers per cubic centimeter or be not greater than the background, whichever is greater. Should any of the final samples indicate a higher value take appropriate actions to re-clean the area and repeat the sampling and TEM analysis at the Contractor's expense.

3.2.13.6 Air Clearance Failure

If clearance sampling results fail to meet the final clearance requirements, pay all costs associated with the required recleaning, resampling, and analysis, until final clearance requirements are met.

3.2.14 Lock-Down

Prior to removal of plastic barriers and after pre-clearance clean up of gross contamination, the PQP must conduct a visual inspection of all areas affected by the removal in accordance with ASTM E1368. Inspect for any visible fibers. Spray apply a post removal (lock-down) encapsulant to ceiling, walls, floors and other areas exposed in the removal area. The exposed areaincludes but is not limited to plastic barriers, furnishings and articles to be discarded as well as dirty change room, air locks for bag removal and decontamination chambers.

3.2.15 Site Inspection

While performing asbestos engineering control work, the Contractor must be subject to on-site inspection by the Contracting Officer who may be

assisted by or represented by safety or industrial hygiene personnel. If the work is found to be in violation of this specification, the Contracting Officer or his representative will issue a stop work order to be in effect immediately and until the violation is resolved. All related costs including standby time required to resolve the violation must be at the Contractor's expense.

## 3.3 CLEAN-UP AND DISPOSAL

### 3.3.1 Housekeeping

Essential parts of asbestos dust control are housekeeping and clean-up procedures. Maintain surfaces of the asbestos control area free of accumulations of asbestos fibers. Give meticulous attention to restricting the spread of dust and debris; keep waste from being distributed over the general area. Use HEPA filtered vacuum cleaners. DO NOT BLOW DOWN THE SPACE WITH COMPRESSED AIR. When asbestos removal is complete, all asbestos waste is removed from the work-site, and final clean-up is completed, the Contracting Officer will attest that the area is safe before the signs can be removed. After final clean-up and acceptable airborne concentrations are attained but before the HEPA unit is turned off and the enclosure removed, remove all pre-filters on the building HVAC system and provide new pre-filters. Dispose of filters as asbestos contaminated materials. Reestablish HVAC mechanical, and electrical systems in proper working order. The Contracting Officer will visually inspect all surfaces within the enclosure for residual material or accumulated dust or debris. The Contractor must re-clean all areas showing dust or residual materials. If re-cleaning is required, air sample and establish an acceptable asbestos airborne concentration after re-cleaning. The Contracting Officer must agree that the area is safe in writing before unrestricted entry will be permitted. The Government must have the option to perform monitoring to determine if the areas are safe before entry is permitted.

### 3.3.2 Title to Materials

All waste materials, except as specified otherwise, become the property of the Contractor and must be disposed of as specified in applicable local, State, and Federal regulations and herein.

### 3.3.3 Disposal of Asbestos

#### 3.3.3.1 Procedure for Disposal

Contractor will be responsible for handling and disposal of all asbestos containing wastes. Collect asbestos waste, contaminated waste water filters, asbestos contaminated water, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing which may produce airborne concentrations of asbestos fibers and place in sealed fiber-proof, waterproof, non-returnable containers (e.g. double plastic bags 6 mils thick, cartons, drums or cans). Wastes within the containers must be adequately wet in accordance with 40 CFR 61-SUBPART M. Affix a warning and Department of Transportation (DOT) label to each container including the bags or use at least 6 mils thick bags with the approved warnings and DOT labeling preprinted on the bag. Clearly indicate on the outside of each container the name of the waste generator and the location at which the waste was generated. Prevent contamination of the transport vehicle (especially if the transport vehicle is a rented truck likely to be used in the future for non-asbestos purposes). These precautions include

lining the vehicle cargo area with plastic sheeting (similar to work area enclosure) and thorough cleaning of the cargo area after transport and unloading of asbestos debris is complete. Dispose of waste asbestos material at an Environmental Protection Agency (EPA) or State-approved asbestos landfill off Government property. For temporary storage, store sealed impermeable bags in asbestos waste drums or skids. An area for interim storage of asbestos waste-containing drums or skids will be assigned by the Contracting Officer or his authorized representative. Comply with 40 CFR 61-SUBPART M, State, regional, and local standards for hauling and disposal. Sealed plastic bags may be dumped from drums into the burial site unless the bags have been broken or damaged. Damaged bags must remain in the drum and the entire contaminated drum must be buried. Uncontaminated drums may be recycled. Workers unloading the sealed drums must wear appropriate respirators and personal protective equipment when handling asbestos materials at the disposal site.

3.3.3.2 Asbestos Disposal Quantity Report

Direct the PQP to record and report, to the Contracting Officer, the amount of asbestos containing material removed and released for disposal. Deliver the report for the previous day at the beginning of each day shift with amounts of material removed during the previous day reported in linear feet or square feet as described initially in this specification and in cubic feet for the amount of asbestos containing material released for disposal.

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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.

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

| | |
|---|---|
| ASSP Z9.2 | (2018) Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 701 | (2019) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films |

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1926.21 | Safety Training and Education |
| 29 CFR 1926.33 | Access to Employee Exposure and Medical Records |
| 29 CFR 1926.55 | Gases, Vapors, Fumes, Dusts, and Mists |
| 29 CFR 1926.59 | Hazard Communication |
| 29 CFR 1926.62 | Lead |
| 29 CFR 1926.65 | Hazardous Waste Operations and Emergency Response |
| 29 CFR 1926.103 | Respiratory Protection |
| 40 CFR 260 | Hazardous Waste Management System: General |
| 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 268 | Land Disposal Restrictions |
| 49 CFR 172 | Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements |
| 49 CFR 178 | Specifications for Packagings |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 586 | (2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units |

1.2 DEFINITIONS

1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8-hour period.

1.2.2 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel (approximately 5 to 6 feet above the floor).

1.2.3 Certified Industrial Hygienist (CIH)

As used in this section refers to a person retained by the Contractor who is certified as an industrial hygienist and who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations. CIH must be certified for comprehensive practice by the American Board of Industrial Hygiene. The Certified Industrial Hygienist must be independent of the Contractor and must have no employee or employer relationship which could constitute a conflict of interest.

1.2.4 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations and has the authority to take prompt corrective actions to control the lead hazard. The Contractor may provide more than one CP as required to supervise and monitor the work. The CP must be a Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene or a Certified

Safety Professional (CSP) certified by the Board of Certified Safety Professionals or a licensed lead-based paint abatement Supervisor/Project Designer in the State of South Dakota.

1.2.5 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.6 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.7 Deleading

Activities conducted by a person who offers to eliminate lead-based paint or lead-based paint hazards or to plan such activities in commercial buildings, bridges or other structures.

1.2.8 Eight-Hour Time Weighted Average (TWA)

Airborne concentration of lead to which an employee is exposed, averaged over an 8-hour workday as indicated in 29 CFR 1926.62.

1.2.9 High Efficiency Particulate Air (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead contaminated particulate. A high efficiency particulate filter demonstrates at least 99.97 percent efficiency against 0.3 micron or larger size particles.

1.2.10 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excludes other forms of organic lead compounds.

1.2.11 Lead-Based Paint (LBP)

Paint or other surface coating that contains lead in excess of 1.0 milligrams per centimeter squared or 0.5 percent by weight.

1.2.12 Lead Control Area

A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

1.2.13 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8-hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than 8-hours in a work day, determine the PEL by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.14 Material Containing Lead/Paint with Lead (MCL/PWL)

Any material, including paint, which contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint or MCL using laboratory instruments with specified limits of detection (usually 0.01 percent). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method. All painted materials have the potential to contain measurable amount of lead as determined by laboratory testing.

1.2.15 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8-hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples must be representative of the employees' work tasks. Breathing zone must be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

1.2.16 Physical Boundary

Area physically roped or partitioned off around lead control area to limit unauthorized entry of personnel.

1.3 DESCRIPTION

Construction activities impacting PWL or material containing lead which are covered by this specification include the demolition or removal of material containing lead. The work covered by this section includes work tasks and the precautions specified in this section for the protection of building occupants and the environment during and after the performance of the hazard abatement activities.

1.3.1 Protection of Existing Areas To Remain

Project work including, but not limited to, lead hazard abatement work, storage, transportation, and disposal must be performed without damaging or contaminating adjacent work and areas. Where such work or areas are damaged or contaminated, restore work and areas to the original condition.

1.3.2 Coordination with Other Work

Coordinate with work being performed in adjacent areas to ensure there are no exposure issues. Explain coordination procedures in the Lead Compliance Plan and describe how the Contractor will prevent lead exposure to other contractors and Government personnel performing work unrelated to lead activities.

1.3.3 Sampling and Analysis

Submit a log of the analytical results from sampling conducted during the abatement. Keep the log of results current with project activities and brief the results to the Contracting Officer as analytical results are reported.

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 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

Competent Person Qualifications

Training Certification

Medical Examinations

Lead Waste Management Plan; G, RO

Licenses, Permits and Notifications

Lead Compliance Plan; G, RO

Written Evidence of TSD Approval

SD-03 Product Data

Respirators

Vacuum Filters

Negative Air Pressure System

Materials and Equipment

Expendable Supplies

Local Exhaust Equipment

Pressure Differential Automatic Recording Instrument

Pressure Differential Log

SD-06 Test Reports

Sampling and Analysis

Occupational and Environmental Assessment Data Report

Sampling Results

Pressure Differential Recordings For Local Exhaust System

SD-07 Certificates

Testing Laboratory

SD-11 Closeout Submittals

Hazardous Waste Manifest; G, DO

Turn-In Documents or Weight Tickets

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Competent Person (CP)

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph COMPETENT PERSON (CP) RESPONSIBILITIES. Provide documented construction project-related experience with implementation of OSHA's Lead in Construction standard ( 29 CFR 1926.62) which shows ability to assess occupational and environmental exposure to lead; experience with the use of respirators, personal protective equipment and other exposure reduction methods to protect employee health. Demonstrate a minimum of 3 years experience implementing OSHA's Lead in Construction standard (29 CFR 1926.62). Submit proper documentation that the CP is trained and certified in accordance with federal, State of South Dakota and local laws. The competent person must be a licensed lead-based paint abatement Supervisor/Project Designer in the State of South Dakota.

1.5.1.2 Training Certification

Submit a certificate for each worker and supervisor, signed and dated by the accredited training provider, stating that the employee has received the required lead training specified in 29 CFR 1926.62 and is certified to perform or supervise deleading, lead removal or demolition activities in the State of South Dakota.

1.5.1.3 Testing Laboratory

Submit the name, address, and telephone number of the testing laboratory selected to perform the air analysis, testing, and reporting of airborne concentrations of lead. Use a laboratory participating in the EPA National Lead Laboratory Accreditation Program (NLLAP) by being accredited by either the American Association for Laboratory Accreditation (A2LA) or the American Industrial Hygiene Association (AIHA) and that is successfully participating in the Environmental Lead Proficiency Analytical Testing (ELPAT) program to perform sample analysis. Laboratories selected to perform blood lead analysis must be OSHA approved.

1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

a. Verify training meets all federal, State, and local requirements.

b. Review and approve Lead Compliance Plan for conformance to the applicable referenced standards.

c. Continuously inspect LBP/PWL or MCL work for conformance with the approved plan.

d. Perform (or oversee performance of) air sampling. Recommend upgrades or downgrades (whichever is appropriate based on exposure) on the use of PPE (respirators included) and engineering controls.

e. Ensure work is performed in strict accordance with specifications at all times.

f. Control work to prevent hazardous exposure to human beings and to the environment at all times.

g. Supervise final cleaning of the lead control area, take clearance wipe samples if necessary; review clearance sample results and make recommendations for further cleaning.

h. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead Compliance Plan

Submit a detailed job-specific plan of the work procedures to be used in the disturbance of lead, LBP/PWL or MCL. Include in the plan a sketch showing the location, size, and details of lead control areas, critical barriers, physical boundaries, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, work practices, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking, hygiene facilities and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and dust containing lead and debris, air sampling, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside of the lead control area. Include site preparation, cleanup and clearance procedures. Include occupational and environmental sampling, training and strategy, sampling and analysis strategy and methodology, frequency of sampling, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multicontractor worksites to inform affected employees and to clarify responsibilities to control exposures.

1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the Contracting Officer within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of 29 CFR 1926.62, the Contractor must provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of 29 CFR 1926.62 and supporting the Lead Compliance Plan.

a. The initial monitoring must represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data must represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable

abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment must determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

1.5.2.4 Medical Examinations

Submit pre-work blood lead levels and post-work blood lead levels for all workers performing lead activities during the execution of the work. Initial medical surveillance as required by 29 CFR 1926.62 must be made available to all employees exposed to lead at any time (one day) above the action level. Full medical surveillance must be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records must show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62 and 29 CFR 1926.103. Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62. Maintain complete and accurate medical records of employees for the duration of employment plus 30 years.

1.5.2.5 Training

Train each employee performing work that disturbs lead who performs LBP/MCL/PWL disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62 and State of South Dakota and local regulations where appropriate.

1.5.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by 29 CFR 1926.103, 29 CFR 1926.62 and 29 CFR 1926.55.

1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.5.2.8 Lead Waste Management

The Lead Waste Management Plan must comply with applicable requirements of federal, State, and local hazardous waste regulations and address:

a. Identification and classification of wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and operator and a 24-hour point of contact. Furnish two copies of USEPA hazardous waste manifests and USEPA Identification numbers.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

g. Work plan and schedule for waste containment, removal and disposal. Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers. Clean up and containerize wastes daily.

h. Include any process that may alter or treat waste rendering a hazardous waste non hazardous.

i. Unit cost for hazardous waste disposal according to this plan.

1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, State, and local authorities regarding lead. Comply with the applicable requirements of the current issue of 29 CFR 1926.62, EM 385-1-1. Submit matters regarding interpretation of standards to the Contracting Officer for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirements apply.

Licensing and certification in the state of South Dakota is required.

1.5.3 Pressure Differential Recordings for Local Exhaust System

Provide a local exhaust system that creates a negative pressure of at least 0.02 inches of water relative to the pressure external to the enclosure and operate it continuously, 24-hours a day, until the temporary enclosure of the lead control area is removed. Submit pressure differential recordings for each work day to the PQP for review and to the Contracting Officer within 24-hours from the end of each work day.

1.5.4 Licenses, Permits and Notifications

Certify and submit in writing to the Contracting Officer at least 10 days prior to the commencement of work that licenses, permits and notifications have been obtained. All associated fees or costs incurred in obtaining the licenses, permits and notifications are included in the contract price.

1.5.5 Pre-Construction Conference

Along with the CP, meet with the Contracting Officer to discuss in detail the Lead Waste Management Plan and the Lead Compliance Plan, including procedures and precautions for the work.

## 1.6 EQUIPMENT

### 1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust, fume and mist. Respirators must comply with the requirements of 29 CFR 1926.62.

### 1.6.2 Special Protective Clothing

Personnel exposed to lead contaminated dust must wear proper disposable protective whole body clothing, head covering, gloves, eye, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

### 1.6.3 Rental Equipment Notification

If rental equipment is to be used during PWL or MCL handling and disposal, notify the rental agency in writing concerning the intended use of the equipment.

### 1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

### 1.6.5 Equipment for Government Personnel

Furnish the Contracting Officer with two complete sets of personal protective equipment (PPE) daily, as required herein, for entry into and inspection of the lead removal work within the lead controlled area. Personal protective equipment must include disposable whole body covering, including appropriate foot, head, eye, and hand protection. PPE remains the property of the Contractor. The Government will provide respiratory protection for the Contracting Officer.

### 1.6.6 Abrasive Removal Equipment

The use of powered machine for vibrating, sanding, grinding, or abrasive blasting is prohibited unless equipped with local exhaust ventilation systems equipped with high efficiency particulate air (HEPA) filters.

### 1.6.7 Negative Air Pressure System

#### 1.6.7.1 Minimum Requirements

Do not proceed with work in the area until containment is set up and HEPA filtration systems are in place. The negative air pressure system must meet the requirements of ASSP Z9.2 including approved HEPA filters in accordance with UL 586. Negative air pressure equipment must be equipped with new HEPA filters, and be sufficient to maintain a minimum pressure differential of minus 0.02 inch of water column relative to adjacent, unsealed areas. Negative air pressure system minimum requirements are listed as follows:

a. The unit must be capable of delivering its rated volume of air with a clean first stage filter, an intermediate filter and a primary HEPA filter in place.

b. The HEPA filter must be certified as being capable of trapping and retaining mono-disperse particles as small as 0.3 micrometers at a minimum efficiency of 99.97 percent.

c. The unit must be capable of continuing to deliver no less than 70 percent of rated capacity when the HEPA filter is 70 percent full or measures 2.5 inches of water static pressure differential on a magnehelic gauge.

d. Equip the unit with a manometer-type negative pressure differential monitor with minor scale division of 0.02 inch of water and accuracy within plus or minus 1.0 percent. The manometer must be calibrated daily as recommended by the manufacturer.

e. Equip the unit with a means for the operator to easily interpret the readings in terms of the volumetric flow rate of air per minute moving through the machine at any given moment.

f. Equip the unit with an electronic mechanism that automatically shuts the machine off in the event of a filter breach or absence of a filter.

g. Equip the unit with an audible horn that sounds an alarm when the machine has shut itself off.

h. Equip the unit with an automatic safety mechanism that prevents a worker from improperly inserting the main HEPA filter.

1.6.7.2 Auxiliary Generator

Provide an auxiliary generator with capacity to power a minimum of 50 percent of the negative air machines at any time during the work. When power fails, the generator controls must automatically start the generator and switch the negative air pressure system machines to generator power. The generator must not present a carbon monoxide hazard to workers.

1.6.8 Vacuum Systems

Vacuum systems must be suitably sized for the project, and filters must be capable of trapping and retaining all mono-disperse particles as small as 0.3 micrometers (mean aerodynamic diameter) at a minimum efficiency of 99.97 percent. Properly dispose of used filters that are being replaced.

1.6.9 Heat Blower Guns

Heat blower guns must be flameless, electrical, paint-softener type with controls to limit temperature to 1,100 degrees F. Heat blower must be (grounded) 120 volts ac, and must be equipped with cone, fan, glass protector and spoon reflector nozzles.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better as determined by the Contracting Officer.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

Keep materials and equipment needed to complete the project available and on the site. Submit a description of the materials and equipment required; including Safety Data Sheets (SDSs) for material brought onsite to perform the work.

#### 2.1.1 Expendable Supplies

Submit a description of the expendable supplies required.

##### 2.1.1.1 Polyethylene Bags

Disposable bags must be polyethylene plastic and be a minimum of 6 mils thick (4 mils thick if double bags are used) or any other thick plastic material shown to demonstrate at least equivalent performance; and capable of being made leak-tight. Leak-tight means that solids, liquids or dust cannot escape or spill out.

##### 2.1.1.2 Polyethylene Leak-tight Wrapping

Wrapping used to wrap lead contaminated debris must be polyethylene plastic that is a minimum of 6 mils thick or any other thick plastic material shown to demonstrate at least equivalent performance.

##### 2.1.1.3 Polyethylene Sheeting

Sheeting must be polyethylene plastic with a minimum thickness of 6 mil, or any other thick plastic material shown to demonstrate at least equivalent performance; and be provided in the largest sheet size reasonably accommodated by the project to minimize the number of seams. Where the project location constitutes an out of the ordinary potential for fire, or where unusual fire hazards cannot be eliminated, provide flame-resistant polyethylene sheets which conform to the requirements of NFPA 701.

##### 2.1.1.4 Tape and Adhesive Spray

Tape and adhesive must be capable of sealing joints between polyethylene sheets and for attachment of polyethylene sheets to adjacent surfaces. After dry application, tape or adhesive must retain adhesion when exposed to wet conditions, including amended water. Tape must be minimum 2 inches wide, industrial strength.

##### 2.1.1.5 Containers

When used, containers must be leak-tight and be labeled in accordance with EPA, DOT and OSHA standards.

##### 2.1.1.6 Chemical Paint Strippers

Chemical paint strippers must not contain methylene chloride and be formulated to prevent stain, discoloration, or raising of the substrate materials.

2.1.1.7 Chemical Paint Stripper Neutralizer

Neutralizers for paint strippers must be compatible with the substrate and suitable for use with the chemical stripper that has been applied to the surface.

2.1.1.8 Detergents and Cleaners

Detergents or cleaning agents must not contain trisodium phosphate and have demonstrated effectiveness in lead control work using cleaning techniques.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the Contracting Officer 20 days prior to the start of any lead work.

3.1.1.2 Lead Control Area

a. Physical Boundary - Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside of the lead control area. Prohibit the general public from accessing the lead control areas.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs must comply with the requirements of 29 CFR 1926.62.

3.1.1.3 Furnishings

Furniture and equipment will remain in the lead control area. Protect and cover furnishings or remove furnishings from the work area and store in a location approved by the Contracting Officer.

3.1.1.4 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area. Provide temporary HVAC system for areas in which HVAC has been shut down outside the lead control area.

3.1.1.5 Local Exhaust System

Provide a local exhaust system in the lead control area in accordance with ASSP Z9.2, 29 CFR 1926.62 that will provide at least 4 air changes per hour inside of the negative pressure enclosure. Local exhaust equipment must be operated 24-hours per day, until the lead control area is removed and must be leak proof to the filter and equipped with HEPA filters. Maintain a minimum pressure differential in the lead control area of minus

0.02 inch of water column relative to adjacent, unsealed areas. Provide continuous 24-hour per day monitoring of the pressure differential with a pressure differential automatic recording instrument. The building ventilation system must not be used as the local exhaust system for the lead control area. Filters on exhaust equipment must conform to ASSP Z9.2 and UL 586. Terminate the local exhaust system out of doors and remote from any public access or ventilation system intakes.

3.1.1.6 Negative Air Pressure System Containment

a. Operate the negative air pressure systems to provide at least 4 air changes per hour inside the containment. Operate the local exhaust unit equipment continuously until the containment is removed. Smoke test the negative air pressure system for leaks at the beginning of each shift. The certified supervisor is responsible to continuously monitor and keep a pressure differential log with an automatic manometric recording instrument. Notify the Contracting Officer immediately if the pressure differential falls below the prescribed minimum. Submit the continuously monitored pressure differential log, as specified. Do not use the building ventilation system as the local exhaust system. Terminate the local exhaust system out of doors unless the Contracting Officer allows an alternate arrangement. All filters must be new at the beginning of the project and be periodically changed as necessary to maintain specified pressure differential and disposed of as lead contaminated waste.

b. Discontinuing Negative Air Pressure System. Operate the negative air pressure system continuously during abatement activities unless otherwise authorized by the Contracting Officer. At the completion of the project, units must be run until full cleanup has been completed and final clearance testing requirements have been met. Dismantling of the negative air pressure systems must be as presented in the Lead Compliance Plan. Seal the HEPA filter machine intakes with polyethylene to prevent environmental contamination.

3.1.1.7 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

3.1.1.8 Eye Wash Station

Provide suitable facilities within the work area for quick drenching or flushing of the eyes where eyes may be exposed to injurious corrosive materials.

3.1.1.9 Mechanical Ventilation System

a. Use adequate ventilation to control personnel exposure to lead in accordance with 29 CFR 1926.62. To the extent feasible, use local exhaust ventilation or other collection systems, approved by the CP. Evaluate and maintain local exhaust ventilation systems in accordance with 29 CFR 1926.62.

b. Vent local exhaust outside the building and away from building ventilation intakes or ensure system is connected to HEPA filters.

c. Use locally exhausted, power actuated tools or manual hand tools.

3.1.1.10 Personnel Protection

Personnel must wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.2 ERECTION

3.2.1 Lead Control Area Requirements

Establish a lead control area by completely establishing barriers and physical boundaries around the area or structure where PWL or MCL removal operations will be performed.

Full containment - Contain removal operations by the use of a negative pressure enclosure system with decontamination facilities and with HEPA filtered exhaust if required by the CP. For containment areas larger than 1,000 square feet install a minimum of two 18 inch square viewing ports. Locate ports to provide a view of the required work from the exterior of the enclosed contaminated area. Glaze ports with laminated safety glass.

3.3 APPLICATION

3.3.1 Lead Work

Perform lead work in accordance with approved Lead Compliance Plan. Use procedures and equipment required to limit occupational exposure and environmental contamination with lead when the work is performed in accordance with 29 CFR 1926.62 and as specified herein. Dispose of all PWL or MCL and associated waste in compliance with federal, State, and local requirements.

3.3.2 Paint with Lead or Material Containing Lead Removal

Manual or power sanding or grinding of lead surfaces or materials is not permitted unless tools are equipped with HEPA attachments or wet methods. The dry sanding or grinding of surfaces that contain lead is prohibited. Provide methodology for removing lead in the Lead Compliance Plan. Select lead removal processes to minimize contamination of work areas outside the control area with lead contaminated dust or other lead contaminated debris or waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this removal process in the Lead Compliance Plan.

Avoid deterioration of the substrate. Provide surface preparations for painting in accordance with Section 09 90 00 PAINTS AND COATINGS.

Provide methodology for lead, LBP/PWL abatement/control and processes to minimize contamination of work areas outside the control area with lead contaminated dust or other lead contaminated debris/waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this lead, LBP/PWL removal/control process in the Lead Compliance Plan.

3.3.2.1 Paint with Lead or Material Containing Lead - Indoor Removal

Perform manual removal in the lead control areas using enclosures,

barriers or containments and powered locally exhausted tools equipped with HEPA filters. Collect residue and debris for disposal in accordance with federal, State, and local requirements.

3.3.2.2 Paint with Lead or Material Containing Lead - Outdoor Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the Lead Compliance Plan. The worksite preparation (barriers or containments) must be job dependent and presented in the Lead Compliance Plan.

3.3.3 Personnel Exiting Procedures

Whenever personnel exit the lead controlled area, they must perform the following procedures and must not leave the work place wearing any clothing or equipment worn in the control area:

a. Vacuum all clothing before entering the contaminated change room.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing, move to an appropriate shower facility, shower.

d. Change to clean clothes prior to leaving the clean clothes storage area.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

3.4.1.1 Air Sampling

Conduct sampling for lead in accordance with 29 CFR 1926.62 and as specified herein. Air sampling must be directed or performed by the CP.

a. The CP must be on the job site directing the air sampling and inspecting the PWL or MCL removal work to ensure that the requirements of the contract have been satisfied during the entire PWL or MCL operation.

b. Collect personal air samples on employees who are anticipated to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least twenty-five percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air samples, signed by the CP, within 72-hours after the air samples are taken.

d. Conduct area air sampling daily, on each shift in which lead and lead-based paint removal operations are performed, in areas immediately adjacent to the lead control area. Conduct sufficient area monitoring to ensure unprotected personnel are not exposed at or above 30 micrograms of lead per cubic meter of air. If 30 micrograms of lead per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the Contracting Officer immediately. Determine if condition(s) require any

further change in work methods. Resume removal work only after the CP and the Contracting Officer give approval.

## 3.5 CLEANING AND DISPOSAL

### 3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of dust and debris. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the lead operation has been completed, clean the controlled area of all visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the Lead Compliance Plan. Reclean areas showing dust or debris. After visible dust and debris is removed, wet wipe and HEPA vacuum all surfaces in the controlled area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP must then certify in writing that the area has been cleaned of lead contamination before clearance testing.

### 3.5.2 Disposal

a. Dispose of material, whether hazardous or non-hazardous in accordance with all laws and provisions and all federal, State or local regulations. Ensure all waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

b. Contractor is responsible for segregation of waste. Collect lead contaminated waste, scrap, debris, bags, containers, equipment, and lead contaminated clothing that may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 261, 40 CFR 262 and corresponding state regulations.

c. Dispose of lead contaminated material classified as hazardous waste at an EPA or State approved hazardous waste treatment, storage, or disposal facility off Government property.

d. Accumulate waste materials in U.S. Department of Transportation ( 49 CFR 178) approved 55 gallon drums or appropriately sized container for smaller volumes. Properly label each drum to identify the type of hazardous material (49 CFR 172). For hazardous waste, the collection container requires marking/labeling in accordance with 40 CFR 262 and corresponding state regulations during the accumulation/collection timeframe. The Contracting Officer or an authorized representative will assign an area for accumulation of waste containers. Coordinate authorized accumulation volumes and time limits with the host installation environmental function.

e. Handle, store, transport, and dispose lead or lead contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

f. All lead waste generation, management,and disposal will be coordinated with the host installation environmental function.

3.5.2.1 Disposal Documentation

Coordinate all disposal or off-site shipments of lead waste with the host installation environmental function. Submit written evidence of TSD approval to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA, State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Provide a certificate that the waste was accepted by the disposal facility. Provide turn-in documents or weight tickets for non-hazardous waste disposal.

3.5.2.2 Payment for Hazardous Waste

Payment for disposal of hazardous and non-hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility is received and approved by the Contracting Officer. The manifest must detail and certify the amount of lead containing materials or non-hazardous waste delivered to the treatment or disposal facility.

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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 213R | (2014; E2017) Guide for Structural Lightweight-Aggregate Concrete |
| 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 305.1 | (2014) Specification for Hot Weather Concreting |
| 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 308.1 | (2011) Specification for Curing 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) |
| 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 |

AMERICAN HARDBOARD ASSOCIATION (AHA)

| | |
|---|---|
| AHA A135.4 | (1995; R 2004) Basic Hardboard |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| 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 A53/A53M | (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A615/A615M | (2022) 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 A780/A780M | (2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| ASTM A934/A934M | (2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars |
| 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 |

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| | of Concrete |
| ASTM C78/C78M | (2022) 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 C136/C136M | (2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| 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 | (2022) 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 | (2022) 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; E 2022) Standard Specification for Chemical Admixtures for Concrete |
| ASTM C567/C567M | (2019) Determining Density of Structural Lightweight 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 C803/C803M | (2018) Standard Test Method for Penetration Resistance of Hardened Concrete |

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| 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) |

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| ASTM C1602/C1602M | (2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement 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 | (2022) Standard Test Methods for Gravimetric Determination ofWater 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)

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| FSC STD 01 001 | (2015) Principles and Criteria for Forest Stewardship |

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

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|---|---|
| NIST PS 1 | (2009) DOC Voluntary Product Standard PS 1-07, Structural Plywood |

U.S. ARMY CORPS OF ENGINEERS (USACE)

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| COE CRD-C 104 | (1980) Method of Calculation of the Fineness Modulus of Aggregate |
| COE CRD-C 513 | (1974) Corps of Engineers Specifications for Rubber Waterstops |
| COE CRD-C 572 | (1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops |

U.S. GREEN BUILDING COUNCIL (USGBC)

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|---|---|
| LEED NC | (2013) Leadership in Energy and Environmental Design(tm) New Construction Rating System |

1.2 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, slag cement, and silica fume.

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, silica fume, 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 in brackets in 1.3SUBMITTALS

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

Quality Control Plan; G

Quality Control Personnel Certifications; G

Quality Control Organizational Chart

Laboratory Accreditation; G

Form Removal Schedule; G

Maturity Method Data

SD-02 Shop Drawings

Formwork

Reinforcing Steel; G-AE

SD-03 Product Data

Joint Sealants; (LEED NC)

Joint Filler; (LEED NC)

Formwork Materials

Cementitious Materials; (LEED NC)

Vapor Retarder

Concrete Curing Materials

Reinforcement; (LEED NC)

Liquid Chemical Floor Hardeners and Sealers

Admixtures

Mechanical Reinforcing Bar Connectors

Waterstops

Local/Regional Materials; (LEED NC)

Biodegradable Form Release Agent

Pumping Concrete

Finishing Plan

Nonshrink Grout

SD-05 Design Data

Concrete Mix Design; G

Formwork Calculations

SD-06 Test Reports

Concrete Mix Design; G-AE

Fly Ash

Pozzolan

Slag Cement

Aggregates

Tolerance Report

Compressive Strength Tests; G-AE

Unit Weight of Structural Concrete; G-AE

Chloride Ion Concentration; G-AE

Air Content; G-AE

Slump Tests; G-AE

Water

SD-07 Certificates

Reinforcing Bars; G-AE

Welder Qualifications

Silica Fume Manufacturer's Representative

VOC Content for Form Release Agents, Curing Compounds, and Concrete Penetrating Sealers

Safety Data Sheets

Forest Stewardship Council (FSC) Certification

Field Testing Technician and Testing Agency

SD-08 Manufacturer's Instructions

Liquid Chemical Floor Hardeners and Sealers

Joint Sealants; (LEED NC)

Curing Compound

## 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 retarder, 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 Formwork Calculations

ACI 347R. Include design calculations indicating arrangement of forms, sizes and grades of supports (lumber), panels, and related components.

Furnish drawings and calculations of shoring and re-shoring methods proposed for floor and roof slabs, spandrel beams, and other horizontal concrete members. Calculations must indicate concrete pressure with both live and dead loads, along with material types.

1.6.1.2 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. Required average strength can be documented by field experience if field strength test data are available and represent a single group of at least 10 consecutive strength tests for one mixture, using materials and conditions similar to those expected for work, and encompassing a period of not less than 45 days. The average of field strength tests shall equal or exceed fcr'. Changes in materials, conditions, and proportions within the test record shall not have been more closely restricted than those for the proposed work. Test records shall not be more than 24 months old. Obtain mix design approval from the contracting officer prior to concrete placement.

1.6.2 Shop Drawings

1.6.2.1 Formwork

Drawings showing details of formwork including, but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Indicate placement schedule, construction, location and method of forming control joints. Include locations of inserts, conduit, sleeves and other embedded items. Reproductions of contract drawings are unacceptable. Submit form removal schedule indicating element and minimum length of time for form removal.

Design, fabricate, erect, support, brace, and maintain formwork so that it is able to support, without failure, all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

1.6.2.2 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 Concrete Curing Plan

Submit proposed materials, methods and duration for curing concrete elements in accordance with ACI 308.1.

1.6.3.2 Pumping Concrete

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

1.6.3.3 Silica Fume Manufacturer's Representative

The manufacturer's representative must be present at mix plant to ensure proper mix, including high range water reducer, and batching methods during the first 3 days of concrete mix preparation and placement. After which the manufacturer's representative must designate a representative at the concrete producer's plant to ensure the concrete mix procedures meet the silica fume manufacturer's recommendations. Representative to attend and advise at finishing of sample slab.

1.6.3.4 Finishing Plan

Submit proposed material and procedures to be used in obtaining the finish for the floors. Include qualification of person to be used for obtaining floor tolerance measurement, description of measuring equipment to be used, and a sketch showing lines and locations the measuring equipment will follow.

1.6.3.5 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.

1.6.3.6 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 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.

1.6.6 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.

1.6.6.1 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.

1.6.6.2 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.

1.6.7 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.

1.6.8 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 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

See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for cumulative total local material requirements. Concrete materials may be locally available.

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.

1.9 QUALIFICATIONS FOR WELDING WORK

Welding procedures must be in accordance with AWS D1.4/D1.4M.

Verify that Welder qualifications are in accordance with AWS D1.4/D1.4M for welding of reinforcement or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

PART 2 PRODUCTS

2.1 FORMWORK MATERIALS

a. Design formwork, shores, reshores, and backshores to support loads transmitted to them and to comply with applicable building code requirements.

b. Design formwork to withstand pressure resulting from placement and vibration of concrete and to maintain specified tolerances.

c. Design formwork to accommodate waterstop materials in joints at locations indicated in Contract Documents.

d. Provide temporary openings in formwork if needed to facilitate cleaning and inspection.

e. Design formwork joints to inhibit leakage of mortar.

f. Limit deflection of facing materials for concrete surfaces exposed to view to 1/400 of center-to-center spacing of facing supports.

g. Submit product information on proposed form-facing materials if different from that specified herein.

h. Submit shop drawings for formwork, shoring, reshoring, and backshoring. Shop drawings must be signed and sealed by a licensed design engineer.

i. Submit design calculations for formwork, shoring, reshoring, and backshoring. Design calculations must be signed and sealed by a licensed design engineer.

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 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.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 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 Plastic Forms

Plastic lumber as specified in Section 06 10 00 ROUGH CARPENTRY.

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. If the breakback distance is less than 3/4 in., use coated or corrosion-resistant ties.

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 product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

b. 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.

c. 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. For members with post-tensioning tendons, locate construction joints where tendons pass through centroid of concrete section.

d. Locate construction joints in walls and columns at underside of slabs, beams, or girders and at tops of footings or slabs.

e. Make construction joints perpendicular to main reinforcement.

f. Provide movement joints where indicated in Contract Documents or in accepted alternate locations.

g. Submit location and detail of movement joints if different from those indicated in Contract Documents.

h. Submit manufacturer's data sheet on expansion joint materials.

i. Provide keyways where indicated in Contract Documents.

2.2.6 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 or Type V for concrete exposed to soil.

b. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

c. 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.

d. Cementitious materials must be stored and kept dry and free from contaminants.

2.3.1.2 Fly Ash

a. ASTM C618, Class F, except that the maximum allowable loss on ignition must not exceed 6 percent.

b. If fly ash is used it shall range from 15 to 30 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,it shall not be used. Report the chemical analysis of the fly ash in accordance with ASTM C311/C311M. Evaluate and classify fly ash in accordance with ASTM D5759.

2.3.1.3 Slag Cement

ASTM C989/C989M, Grade 100.

2.3.1.4 Silica Fume

Silica fume must conform to ASTM C1240, including the optional limits on reactivity with cement alkalis. Silica fume may be furnished as a dry, densified material or as slurry. Proper mixing is essential to accomplish proper distribution of the silica fume and avoid agglomerated silica fume which can react with the alkali in the cement resulting in premature and extensive concrete damage. Supervision at the batch plant, finishing, and curing is essential. Provide at the Contractor's expense the services of a manufacturer's technical representative, experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. This representative must be present on the project prior to and during at least the first 4 days of concrete production and placement using silica fume. A High Range Water Reducing admixture (HRWRA) must be used with silica fume.

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 requirement for uniformity.

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 $SiO_2$ + $Al_2O_3$ + $Fe_2O_3$ 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.

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. 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.

d. 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 Lightweight Aggregate

Lightweight aggregate in accordance with ASTM C330/C330M.

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 a corrosion-inhibiting admixture for concrete classified under exposure category C1 or C2. 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 Floor Finish Materials

#### 2.4.3.1 Liquid Chemical Floor Hardeners and Sealers

a. Hardener must be a colorless aqueous solution containing a blend of inorganic silicate or siliconate material and proprietary components combined with a wetting agent; that penetrates, hardens, and densifies concrete surfaces. Submit manufactures instructions for placement of liquid chemical floor hardener.

b. Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content. Submit manufactures instructions for placement of sealers.

#### 2.4.3.2 Dry Materials for Colored Wear-Resistant Finish

Provide materials that are packaged, dry, and a combination of materials formulated for producing colored and wear-resistant monolithic surface treatments; they must include portland cement, graded-quartz aggregate, coloring pigments, and dispersing agents. Provide coloring pigments that are finely ground, nonfacing mineral oxides prepared especially for the purpose and interground with the cement.

#### 2.4.3.3 Aggregate for Heavy-Duty Wear-Resistant Finish

Provide aggregate that is traprock or emery, as follows:

Traprock must be packaged, crushed, natural, fine-to-medium-grained, igneous rock, such as diabase, basalt, or black granite. Traprock aggregate must be well-graded in size from particles retained on No. 4 sieve 0.187 inch to particles passing 3/8-inch sieve.

Emery must be packaged, factory-graded, crushed, natural-emery ore, cubical or polyhedral in form, containing not less than 35-percent aluminum oxide and not less than 24-percent ferric oxide. Emery aggregate must be well graded in size from particles retained on No. 50 sieve 0.0118 inch to particles passing No. 8 sieve 0.0929 inch.

#### 2.4.3.4 Aggregate for Heavy-Duty Floor Topping

Provide emery (or may be traprock or traprock-screenings) fine aggregates, as specified.

Provide emery that is packaged, factory-graded, crushed natural emery ore containing not less than 35-percent aluminum oxide and not less than 24-percent ferric oxide. Provide aggregate that is cubical or polyhedral in form and does not change its physical or chemical nature in the presence of moisture. Grade aggregate to a fineness modulus of 3.9 to 4.0, with 100 percent passing 3/8-inch sieve and not less than 95 percent retained on No. 100 sieve. Deliver emery in moisture-resistant bags.

Provide traprock that is packaged, crushed, natural, fine- to medium-grained igneous rock such as diabase, basalt, or black granite. Uniformly grade coarse aggregate with 100 percent passing 1/2-inch sieve, 30 to 50 percent passing 3/8-inch sieve, 0 to 15 percent passing No. 4 sieve, and 0 to 5 percent passing No. 8 sieve.

Provide fine aggregate using traprock that conforms to ASTM C33/C33M, except gradation. Grade fine aggregate within the following limits:

| SIEVE | PERCENT PASSING |
|---|---|
| 3/8 in. | 100 |
| No. 4 | 95 to 100 |
| No. 8 | 65 to 80 |
| No. 16 | 45 to 65 |
| No. 30 | 25 to 45 |
| No. 50 | 5 to 15 |
| No. 100 | 0 to 5 |

Deliver traprock coarse aggregate and fine aggregate in moisture-resistant bags.

2.4.4 Expansion/Contraction Joint Filler

ASTM D1751 or ASTM D1752. Material must be 1/2 inch thick, unless otherwise indicated.

2.4.5 Joint Sealants

Submit manufacturer's product data, indicating VOC content.

2.4.5.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D6690 or ASTM C920, Type M, Class 25, Use T.

2.4.5.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C920, Type M, Grade NS, Class 25, Use T.

2.4.5.3 Preformed Polychloroprene Elastomeric Type

ASTM D2628.

2.4.5.4 Lubricant for Preformed Compression Seals

ASTM D2835.

2.4.6 Vapor Retarder

ASTM E1745 Class C polyethylene sheeting, minimum 15 mil thickness or other equivalent material with a maximum permeance rating of 0.04 perms per ASTM E96/E96M.

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.4.7 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.

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/Pile Caps** | 4500<br>at 28 days | S2;<br>C2;<br>W1;<br>F2 | Max. slump: 6 in.<br><br>Nominal maximum aggregate size must be 3/4 in. |
| **Slabs-on-ground** | 4500<br>at 28 days | S2;<br>C2;<br>W1;<br>F2 | Max. slump: 6 in.<br><br>Nominal maximum aggregate size must be 3/4 in. |
| **Lightweight concrete Toppings** | 5000<br>at 28 days | S2;<br>C2;<br>W1;<br>F2 | Max. density of 115 (pounds per cubic foot) |
| **Concrete Toppings** | 4500<br>at 28 days | S2;<br>C2;<br>W1;<br>F2 | Slump 6 to 8 in. at point of placement |

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):

a. For each aggregate used in concrete, the expansion result determined in accordance with ASTM C1293 must not exceed 0.04 percent at one year.

b. 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.

2.5.2.2 Freezing and Thawing Resistance

a. 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 | |

| Exposure class | Maximum *w/cm** | Minimum *f'c*, psi | Air content | Additional Requirements |
|---|---|---|---|---|
| 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 |
| Silica fume conforming to ASTM C1240 | 10 |
| Total of fly ash or other pozzolans, slag cement, and silica fume | 50^ |
| Total of fly ash or other pozzolans and silica fume | 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 |
| 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 C150/C150M | ASTM C595/C595M | ASTM C1157/C1157M | |
| S0 | N/A | 2500 | N/A | N/A | N/A | No restrictions |
| S1 | 0.50 | 4000 | II*^ | Types with (MS) designation | MS | No restrictions |
| S2 | 0.45 | 4500 | V^ | Types with (HS) designation | HS | Not permitted |
| S3 | 0.45 | 4500 | V + pozzolan or slag cement** | Types with (HS) designation plus pozzolan or slag cement** | HS + pozzolan or slag cement** | Not permitted |
| S3 | 0.40 | 5000 | V*** | Types with (HS) designation | HS | 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.

*** If Type V cement is used as the sole cementitious material, the optional sulfate requirement of 0.040 percent maximum expansion in ASTM C150/C150M shall be required.

^ 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 12 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. Field bending or straightening of reinforcing bars partially embedded in concrete is not permitted.

g. 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.

c. Submit mill certificates for reinforcing bars.

2.6.2 Mechanical Reinforcing Bar Connectors

a. Provide mechanical splice type 2 as defined per ACI 318-14.

b. Submit data on mechanical splices demonstrating compliance with this paragraph.

2.6.3 Wire

a. Provide flat sheets of welded wire reinforcement for slabs and toppings.

b. Plain or deformed steel wire must conform to ASTM A1064/A1064M.

2.6.4 Welded wire reinforcement

a. Use welded wire reinforcement specified in Contract Documents and conforming to one or more of the specifications given herein.

b. 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.

2.6.5 Reinforcing Bar Supports

a. 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.

2.6.6 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.

Plate dowels must conform to ASTM A36/A36M, and must be of size and spacing indicated. Plate dowel system must minimize shrinkage restraint by using a tapered shape or formed void or by having compressible material on the vertical faces with a thin bond breaker on the top and bottom dowel surfaces.

2.6.7 Welding

a. Provide weldable reinforcing bars that conform to ASTM A706/A706M.

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.

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 retarder.

b. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder.

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.

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.

l. 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.

3.3.6 Form Ties

a. 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 Forms for Concrete Pan Joist Construction

Pan-form units for one-way or two-way concrete joist and slab construction must be factory-fabricated units of the approximate section indicated. Units must consist of steel or molded fiberglass concrete form pans. Closure units must be furnished as required.

3.3.8 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.

3.3.9 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. Leave formwork and shoring in place to support construction loads and weight of concrete in beams, slabs, and other structural members until in-place required strength of concrete is reached.

e. 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.

3.3.10 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 | 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 Retarder

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 retarder material and provide with new vapor retarder prior to placing concrete. Concrete placement must not damage vapor retarder. Place vapor retarder directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor retarder. In this case, a thin layer of approximately 1/2 inch of fine graded material should be rolled or compacted over the fill before installation of the vapor retarder to reduce the possibility of puncture. Control concrete placement so as to prevent damage to the vapor retarder.

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. Repair the cut ends of hot-dipped galvanized reinforcement steel to completely coat exposed steel, ASTM A780/A780M.

3.5.6 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Caulk the depression after the bolt is installed.

3.5.7 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.

3.5.8 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 be 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.

3.5.9 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.

3.5.10 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.

3.5.11 Concrete Protection for Reinforcement

Additional concrete protection must be in accordance with the Contract Documents.

3.5.12 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 concrete temperature is less than 84 degrees F.

c. Place concrete within 60 minutes if the concrete 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. When fibers are used, add fibers together with the aggregates and never as the first component in the mixer. Fibers must be dispensed into the mixing system using appropriate dispensing equipment and procedure as recommended by the manufacturer.

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. Concrete shall be placed within 15 minutes of discharge into non-agitating equipment.

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 course 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.

3.7.2.1 Pumping Lightweight Concrete

In accordance with ACI 213R unless otherwise specified. Presoak or presaturate aggregates. Cement content must be minimum of 564 pounds per cubic yard and be sufficient to accommodate a 4 to 6 inch slump. Make field trial run in accordance with ACI 213R.

3.7.3 Cold Weather

Cold weather concrete must meet the requirements of ACI 301 and ACI 306.1 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 one 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 and ACI 305.1 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 or on-site area to be paved later in project for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.8.2 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.8.3 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.

## 3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

### 3.9.1 Defects

Repair surface defects in accordance with ACI 301 Section 5.

### 3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

### 3.9.3 Formed Surfaces

#### 3.9.3.1 Tolerances

Tolerances in accordance with ACI 117 and as indicated.

#### 3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view a surface finish SF-1.0. Patch holes and defects in accordance with ACI 301.

#### 3.9.3.3 Standard Smooth Finish

Provide for surfaces exposed to public view a surface finish SF-3.0. Patch holes and defects in accordance with ACI 301.

## 3.10 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 quarry tile, ceramic tile, are indicated. Steel trowel and fine-broom finish concrete slabs that are to receive quarry tile, ceramic tile, or paver tile. Where straightedge measurements are specified, Contractor must provide straightedge.

### 3.10.1 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. Grate tampers ("jitterbugs") shall not be used.

#### 3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. Finish concrete in accordance with ACI 301 Section 5 for a scratched finish.

#### 3.10.1.2 Floated

Use for surfaces to receive roofing, waterproofing membranes, sand bed terrazzo, and exterior slabs where not otherwise specified. Finish concrete in accordance with ACI 301 Section 5 for a floated finish.

3.10.1.3 Concrete Containing Silica Fume

Finish using magnesium floats or darbies.

3.10.1.4 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.

3.10.1.5 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.

3.10.1.6 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.

3.10.1.7 Concrete Toppings Placement

The following requirements apply to the placement of toppings of concrete on base slabs that are either freshly placed and still plastic, or on hardened base slabs.

a. Placing on a Fresh Base: Screed and bull float the base slab. As soon as the water sheen has disappeared, lightly rake the surface of the base slab with a stiff bristle broom to produce a bonding surface for the topping. Immediately spread the topping mixture evenly over the roughened base before final set takes place. Give the topping the finish indicated on the drawings.

b. Bonding to a Hardened Base: When the topping is to be bonded to a floated or troweled hardened base, roughen the base by scarifying, grit-blasting, scabbling, planing, flame cleaning, or acid-etching to lightly expose aggregate and provide a bonding surface. Remove dirt, laitance, and loose aggregate by means of a stiff wire broom. Keep the clean base wet for a period of 12 hours preceding the application of the topping. Remove excess water and apply a 1:1:1/2 cement-sand-water grout, and brush into the surface of the base slab. Do not allow the cement grout to dry, and spread it only short distances ahead of the topping placement. Do not allow the temperature differential between the completed base and the topping mixture to exceed 41 degrees F at the time of placing. Place the topping and finish as specified herein.

3.10.2 Flat Floor Finishes

ACI 302.1R. Construct in accordance with one of the methods recommended in Table 10.15.3a, "Slab-on-ground flatness/levelness construction guide" or Table 10.15.3b, "Suspended slab flatness/levelness construction guide" appropriate for the type of construction. ACI 117 for tolerance tested by ASTM E1155.

a. Specified Industrial:

| | | |
|---|---|---|
| Floor Flatness (Ff) | 30 | 15 minimum |
| Floor Levelness (FL) | 20 | 10 minimum |

3.10.2.1 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.

3.10.2.2 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.

3.10.3 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.

3.10.4 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.5 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.

3.10.6 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.

3.11 JOINTS

3.11.1 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:

3.11.1.1 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.

3.11.2 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.

3.11.3 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.

3.11.4 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.

## 3.12 CONCRETE FLOOR TOPPING

### 3.12.1 Standard Floor Topping

Provide topping for treads and platforms of metal steel stairs and elsewhere as indicated.

#### 3.12.1.1 Preparations Prior to Placing

a. When topping is placed on a green concrete base slab, screed surface of base slab to a level not more than 1-1/2 inches nor less than 1 inch below required finish surface. Remove water and laitance from surface of base slab before placing topping mixture. As soon as water ceases to rise to surface of base slab, place topping.

b. When topping is placed on a hardened concrete base slab, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from base slab surface, leaving a clean surface. Prior to placing topping mixture, 2-1/2-inches minimum, slab surface must be dampened and left free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Do not allow cement grout to set or dry before topping is placed.

c. When topping is placed on a metal surface, such as metal pans for steel stairs, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from metal surface.

#### 3.12.1.2 Placing

Spread standard topping mixture evenly on previously prepared base slab or metal surface, brought to correct level with a straightedge, and struck off. Topping must be consolidated, floated, checked for trueness of surface, and refloated as specified for float finish.

#### 3.12.1.3 Finishing

Give trowel finish standard floor topping surfaces.

Give other finishes standard floor topping surfaces as indicated.

### 3.12.2 Heavy-Duty Floor Topping

Provide topping where indicated.

#### 3.12.2.1 Heavy-duty Topping Mixture

Provide mixture that consists of 1 part portland cement and 2-1/2 parts emery aggregate or 1 part fine aggregate and 1-1/2 parts traprock coarse aggregate, by volume. Exact proportions of mixture must conform to recommendations of aggregate manufacturer. Mixing water must not exceed 3-1/4 gallons per 94-pound sack of cement including unabsorbed moisture in aggregate. Maximum slump must be 1 inch.

3.12.2.2 Base Slab

a. Screed surface of slab to a level no more than 1-1/2 inches nor less than 1 inch below grade of finished floor.

b. Give slab a scratch finish as specified.

c. Preparations prior to placing.

Remove dirt, loose material, oil, grease, asphalt, paint and other contaminants from base slab surface. Prior to placing topping mixture, dampen slab surface and leave free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Allow cement grout to set or dry before topping mixture is placed.

3.12.2.3 Placing

Spread heavy-duty topping mixture evenly on previously prepared base slab, and bring to correct level with a straightedge, and strike off. Provide topping that is consolidated, floated, and checked for trueness of surface as specified for float finish, except that power-driven floats is the impact type.

3.12.2.4 Finishing

Give trowel finish heavy-duty floor topping surfaces. Provide trowel finish as specified, except that additional troweling after first power troweling must be not less than three hand-troweling operations.

3.13 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.

3.13.1 Requirements for Type III, High-Early-Strength Portland Cement

The curing periods are required to be not less than one-fourth of those specified for portland cement, but in no case less than 72 hours.

3.13.2 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.

3.13.3 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.

3.13.4 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 concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.13.5 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 one hour nor 80 degrees F in any 24-hour period.

3.13.6 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.

3.13.7 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

## 3.14 FIELD QUALITY CONTROL

### 3.14.1 Aggregate Testing

#### 3.14.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C136/C136M and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall be immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

#### 3.14.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C136/C136M for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

### 3.14.2 Concrete Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C31/C31M for making test specimens.

### 3.14.3 Concrete Testing

#### 3.14.3.1 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.

#### 3.14.3.2 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.

3.14.3.3 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, two cylinders at 56 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 and 56 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.

3.14.3.4 Air Content

ASTM C173/C173M or ASTM C231/C231M for normal weight concrete and ASTM C173/C173M for lightweight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.14.3.5 Unit Weight of Structural Concrete

ASTM C567/C567M and ASTM C138/C138M. Determine unit weight of normal weight concrete. Perform test for every 20 cubic yards maximum.

3.14.3.6 Chloride Ion Concentration

Chloride ion concentration must meet the requirements of the paragraph titled CORROSION AND CHLORIDE CONTENT. Determine water soluble ion concentration in accordance with ASTM C1218/C1218M. Perform test once for each mix design.

3.14.3.7 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.

3.14.3.8 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.

3.14.3.9 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.

## 3.15 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.

### 3.15.1 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.

### 3.15.2 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.

### 3.15.3 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

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UNIT MASONRY
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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.

AMERICAN CONCRETE INSTITUTE (ACI)

| | |
|---|---|
| ACI 216.1 | (2014) Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies |
| 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 | (2022) 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 C129 | (2017) Standard Specification for Nonloadbearing Concrete Masonry Units |
| ASTM C207 | (2018) Standard Specification for Hydrated Lime for Masonry Purposes |
| ASTM C270 | (2019a; E 2019) Standard Specification for Mortar for Unit Masonry |
| ASTM C476 | (2020) Standard Specification for Grout for Masonry |
| ASTM C494/C494M | (2019; E 2022) Standard Specification for Chemical Admixtures for Concrete |
| ASTM C641 | (2017) Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates |
| ASTM C1019 | (2019) Standard Test Method for Sampling and Testing Grout |
| 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 |

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 |

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-AE

Reinforcement Detail Drawings; G-AE

SD-03 Product Data

Hot Weather Procedures; G-AE

Cold Weather Procedures; G-AE
Cementitious Materials; G-AE

SD-04 Samples

Concrete Masonry Units (CMU); G-RO

Anchors, Ties, and Bar Positioners; G-AE

Joint Reinforcement; G-AE

SD-05 Design Data

Masonry Compressive Strength; G-AE

Fire-Rated Concrete Masonry Units

Bracing Calculations; G-AE

SD-06 Test Reports

Fire-Rated Concrete Masonry Units

Field Testing of Grout

SD-07 Certificates

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SD-08 Manufacturer's Instructions

Admixtures for Grout

SD-10 Operation and Maintenance Data

Take-Back Program

SD-11 Closeout Submittals

Recycled Content of Cement

## 1.3 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.

1.3.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

a. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.3.2 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.

1.3.3 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.

1.4 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

1.4.1 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.

1.4.2 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 as indicated on the Structural Drawings in the Structural Masonry Notes.

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 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. Units may contain post-consumer or post-industrial recycled content.

##### 2.2.2.2.2 Size

Provide units with specified dimension of 8 inches wide, 8 inches high, and 16 inches long, nominal.

##### 2.2.2.2.3 Surfaces

Provide units with exposed surfaces that are smooth and of uniform texture.

##### 2.2.2.2.4 Unit Types

a. Hollow Non-Load-Bearing Units: ASTM C129, lightweight or medium weight or normal weight. Load-bearing units may be provided in lieu of non-load-bearing units.

##### 2.2.2.2.5 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.

2.2.2.3 Fire-Rated Concrete Masonry Units

For indicated fire-rated construction, provide concrete masonry units of minimum equivalent thickness for the fire rating indicated and the corresponding type of aggregates indicated in TABLE I. Units containing more than one of the aggregates listed in TABLE I will be rated by linear interpolation based on the percent by dry-rodded volume of each aggregate used in manufacturing the units.

TABLE I
FIRE-RATED CONCRETE MASONRY UNITS

| Aggregate Type | Minimum Equivalent Thickness for Fire-Resistance Rating, inch | | | | | | |
|---|---|---|---|---|---|---|---|
| | 1/2 hour | 3/4 hour | 1 hour | 1-1/2 hour | 2 hours | 3 hours | 4 hours |
| Calcareous or siliceous gravel (other than limestone) | 2.0 | 2.4 | 2.8 | 3.6 | 4.2 | 5.3 | 6.2 |
| Limestone, cinders, or air-cooled slag | 1.9 | 2.3 | 2.7 | 3.4 | 4.0 | 5.0 | 5.9 |
| Expanded clay, expanded shale, or expanded slate | 1.8 | 2.2 | 2.6 | 3.3 | 3.6 | 4.4 | 5.1 |
| Expanded slag or pumice | 1.5 | 1.9 | 2.1 | 2.7 | 3.2 | 4.0 | 4.7 |

Determine equivalent thickness in accordance with ACI 216.1. Where walls are to receive plaster or be faced with brick, or otherwise form an assembly; include the thickness of plaster or brick or other material in the assembly in determining the equivalent thickness. Submit calculation results.

2.2.2.4 Prefaced Concrete Masonry Units

a. Provide all shapes and sized for a complete installation. Use bullnose units along sills and caps and at vertical external corners including door jambs, window jambs, and other such openings with a bullnose radius of 1 inch. Cove base units to meet finished floor surfaces where ceramic tile floor occurs.

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 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

### 2.5.1 Mortar Mix

a. Provide mortar Type N or S unless specified otherwise herein.

b. Provide Type N or S mortar for non-load-bearing, non-shear-wall interior masonry.

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, fine or coarse that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height. 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 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.

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

Provide reinforcing steel bars and rods conforming 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 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and submit 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, rake joints between frames and abutting masonry walls to a depth of 3/8 inch. On the exterior side of exterior frames,rake joints between frames and abutting masonry walls to a depth of 3/8 inch.

3.3.1.1.4 Joint Widths

a. Provide 3/8 inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.

b. 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.

c. 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. Toothing 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 sash jamb units with control joint key 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. Interrupt the horizontal reinforcement and grout in bond beams at the control joint except in bond beams at the floor and roof diaphragms.

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

Anchor masonry 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.

3.3.5 Sills and Copings

Set sills and copings in a full bed of mortar with faces plumb and true. Slope sills and copings to drain water. Mechanically anchor copings and sills longer than 4 feet as 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. Maintain a minimum clearance of 1/2 inch 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 Horizontal Grout Barriers

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

3.4.2.3 Grout Holes and Cleanouts

3.4.2.3.1 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. Fom 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.

3.4.2.3.2 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.

3.4.2.4 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 30 00 CAST-IN-PLACE 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 Grout

a. Perform grout testing at the following frequency: Refer to Secification 01 45 35. For each required grout property to be evaluated, provide a minimum of three specimens.

b. Sample and test conventional and self-conslidating 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.

### 3.6.2 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 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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**05/22**

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SECTION 05 05 20

POST-INSTALLED CONCRETE AND MASONRY ANCHORS
**05/22**

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 E488/E488M | (2022) Standard Test Methods for Strength of Anchors in Concrete Elements |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IBC | (2018) 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; G

Post-Installed Anchor Special Inspector Qualifications; G

SD-03 Product Data

Mechanical Anchors in Concrete; G-AE

Adhesive Anchor System in Concrete; G-AE

Mechanical and Adhesive Anchors in Masonry; G-AE

Non-Shrink, Non-Metallic Grout; G-AE

SD-06 Test Reports

Post-Installed Anchor Special Inspections Report; G-AE

SD-07 Certificates

Post-Installed Anchor Certification; G-AE

SD-08 Manufacturer's Instructions

Manufacturer's Printed Installation Instructions; G-AE

Non-Shrink, Non-Metallic Grout; G-AE

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 5 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 concrete), and concrete/masonry strength. Minimum allowable strength or 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.

Adhesive anchors must not be used to connect to concrete over metal deck construction nor in overhead applications, like hangers from the existing hangar roof slab.

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 hollow concrete masonry, filled concrete masonry, brick to match the project's actual base material.

Adhesives must be moisture insensitive, low creep, structural adhesive.

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 within1 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 as-built drawings and must use Radar detection systems, X-Ray, or other appropriate means to accurately locate the position of existing reinforcing bars and embedded items at the locations of the anchors in the field. Scanning method must provide enough accuracy and precision to locate the space between rebar. Structural integrity of existing concrete or masonry must not be impaired by investigating method.

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 10 percent of randomly selected anchors. Anchor selection will be determined by the Post-Installed Anchor Special Inspector in coordination with the Contracting Officer and the Engineer of Record.

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 10 percent of randomly selected anchors. Anchor selection will be determined by the Post-Installed Anchor Special Inspector in coordination with the Contracting Officer and the Engineer of Record. 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:

### 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 10 percent of randomly selected anchors. Anchor selection will be determined by the Post-Installed Anchor Special Inspector in coordination with the Contracting Officer and the Engineer of Record. 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:

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 daily. 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.

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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 D1.3/D1.3M | (2018) Structural Welding Code - Sheet Steel |
| AWS D1.4/D1.4M | (2011) Structural Welding Code - Reinforcing Steel |
| AWS D14.4/D14.4M | (2012) Specification for Welded Joints for Machinery and Equipment |
| AWS QC1 | (2016) Specification for AWS Certification of Welding Inspectors |
| AWS Z49.1 | (2021) 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; G

SD-03 Product Data

Welding Procedure Qualifications; G-AE

Welder, Welding Operator, and Tacker Qualification

Previous Qualifications

Pre-Qualified Procedures; G-AE

Welding Electrodes and Rods

SD-06 Test Reports

Nondestructive Testing; G-AE

Weld Inspection Log

SD-07 Certificates

Certified Welding Procedure Specifications (WPS)

Certified Brazing Procedure Specifications (BPS)

Certified Procedure Qualification Records (PQR)

Certified Welder Performance Qualifications (WPQ)

Certified Brazer Performance Qualifications (BPQ)

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 General Requirements

Fabricate work in an AISC Certified Fabrication Plant, Category BU. Erect work by an AISC Certified Erector, Category CSE.

a. For Structural Projects, provide documentation of the following:

(1) Component Thickness 1/8 inch and greater: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.1/D1.1M.

(2) Component Thickness Less than 1/8 inch: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.3/D1.3M.

(3) Reinforcing Steel: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D1.4/D1.4M.

b. For other applications, provide documentation of the following:

(1) Submit two copies of the Certified Welding Procedure Specifications (WPS), Certified Brazing Procedure Specifications (BPS) and Certified Procedure Qualification Records (PQR) to the Contracting Officer for approval.

(2) Submit two copies of the Certified Welder Performance Qualifications (WPQ)and Certified Brazer Performance Qualifications (BPQ) to the Contracting Officer for approval within fifteen calendar days prior to any employee welding on the project material.

(3) Machinery: Qualification documents (WPS, PQR, and WPQ) in accordance with AWS D14.4/D14.4M.

1.3.2 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.

1.3.3 Pre-qualified Procedures

No pre-qualified welding procedures are allowed. Qualify the welding

procedures and welders by tests prescribed in the applicable code or specification not withstanding the fact the code or specification may allow pre-qualified procedures.

1.3.4 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.

1.3.4.1 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.

1.3.4.2 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.

1.3.4.3 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.

1.3.5 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.

1.3.6 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.

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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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO LRFD | (8th Edition; 2017) Bridge Design Specifications |

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

| | |
|---|---|
| AISC 207 | (2016; R 2017) Certification Standard for Steel Fabrication and Erection, and Manufacturing of Metal Components |
| 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 420 | (2010) Certification Standard for Shop Application of Complex Protective Coating Systems |
| 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 |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B46.1 | (2020) Surface Texture, Surface Roughness, Waviness and Lay |

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 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 A563 | (2015) Standard Specification for Carbon and Alloy Steel Nuts |
| ASTM A668/A668M | (2022) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use |
| ASTM B695 | (2021) 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 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 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, with Change 1, 2022) Structural Engineering |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR Part 1926, Subpart R | Steel Erection |

## 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; G-AE

SD-02 Shop Drawings

Fabrication Drawings Including Details of Connections; G-AE

SD-03 Product Data

Shop Primer

Welding Electrodes and Rods

Direct Tension Indicator Washers

Non-Shrink Grout; G-AE

Tension Control Bolts; G-AE

SD-05 Design Data

Design Calculations for Steel Connections; G-AE

Shoring and Temporary Bracing; G-AE

SD-06 Test Reports

Class B Coating

Bolts, Nuts, and Washers

Weld Inspection Reports

Direct Tension Indicator Washer Inspection Reports

Bolt Testing Reports

SD-07 Certificates

Steel

Bolts, Nuts, and Washers

Galvanizing

Pins and Rollers

AISC Structural Steel Fabricator Quality Certification

AISC Structural Steel Erector Quality Certification

Welding Procedures and Qualifications

Welding Electrodes and Rods

Certified Welding Inspector

NDT Technician

Welding Procedure Specifications (WPS)

1.3 AISC QUALITY CERTIFICATION

Work must be fabricated by an AISC Certified Structural Steel Fabricator, in accordance with AISC 207, Category BU. Submit AISC Structural Steel Fabricator quality certification.

Work must be erected by an AISC Structural Steel Certified Erector, in

accordance with AISC 207, Category CSE. Submit AISC Structural Steel erector quality certification.

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. Erection drawings must be reviewed, stamped and sealed by a registered professional engineer.

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. Shoring and temporary bracing must be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. 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 Delegated Connection Design

Design structural steel connection indicated in the contract documents per AISC 303, Option 3, using the connection loads indicated. Submit design calculations for steel connections signed and sealed by a registered professional engineer.

1.4.4 Certifications

1.4.4.1 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 and/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

Refer to structural drawings.

2.2.2 Structural Steel Tubing

Refer to structural drawings.

2.2.3 Steel Pipe

Refer to structural drawings.

2.3 BOLTS, NUTS, AND WASHERS

Submit 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.

2.3.1 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 pretentioned installation without stripping. The supplier shall supply nuts that have been lubricated and tested with the supplied bolts.

2.3.1.1 Bolts

Refer to structural drawings.

2.3.1.2 Nuts

Refer to structural drawings.

2.3.1.3 Direct Tension Indicator Washers

ASTM F959/F959M. Submit product data for direct tension indicator washers.

2.3.1.4 Washers

Refer to structural drawings.

2.3.2 Tension Control Bolts

ASTM F3125/F3125M, Grade F1852, Type 1, twistoff style assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon steel nuts, and hardened carbon steel washers. Assembly finish must be plain. Submit product data for tension control bolts.

2.3.3 Foundation Anchorage

2.3.3.1 Anchor Rods

Refer to structural drawings.

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. Grout must be nonmetallic. 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.

2.4.4 Pins and Rollers

ASTM A668/A668M, Class C, D, F, or G; ASTM A108, Grades 1016 to 1030. Provide as specified in AASHTO LRFD, Section 6.4.2, except provide pins in lengths to extend a minimum of 0.25 inch beyond the outside faces of the connected parts.

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 and pin 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.

Do not splice truss top and bottom chords except as approved by the Contracting Officer. Provide chord splices at panel joints at approximately the third point of the span. The center of gravity lines of truss members must intersect at panel points unless otherwise approved by the Contracting Officer. When the center of gravity lines do not intersect at a panel point, make provisions for the stresses due to eccentricity. Camber of trusses must be 1/8 inch in 10 feet unless otherwise indicated.

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 to receive sprayed-on fireproofing, surfaces to receive epoxy coatings, 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 in accordance with endorsement "SPE-P1" of AISC 420 or approved equal NACE or SSPC certification to a minimum dry film thickness of 2.0 mil. Submit shop primer product data.

Prime slip critical surfaces with a Class B coating in accordance with AISC 325. Submit test report for Class B coating.

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.

2.6.3 Fireproofing and Epoxy Coated Surfaces

Clean and prepare surfaces to receive sprayed-on fireproofing and epoxy coatings in accordance with the manufacturer's recommendations.

2.6.4 Surface Finishes

ASME B46.1 maximum surface roughness of 125 for pin, pinholes, and sliding bearings, unless indicated otherwise.

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 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.

3.2.1.1 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 LIW, provide flat washers under both the bolt head and nut when ASTM F3125/F3125M, Grade A490 bolts are used.

3.2.2 Tension Control Bolts

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.

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. 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 backing strips from bottom flange of moment connections, backgouge the root pass to sound weld metal and reinforce with a 5/16 inch fillet weld minimum.

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 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.

3.6.1 Welds

3.6.1.1 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.

3.6.1.2 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 coordinated with the Contracting Officer. 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:

| Test Type | Number of Tests |
|---|---|
| Ultrasonic | 50 percent of CJP Welds |
| Magnetic Particle | 50 percent of PJP and Fillet Welds |
| Dye Penetrant | 50 percent of PJP and Fillet Welds |

3.6.2 Direct Tension Indicator Washers

3.6.2.1 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.

3.6.2.2 Direct Tension Indicator Gaps

In addition to the above testing, an independent testing agency as approved by the Contracting Officer, must test in place the direct tension indicator gaps on 20 percent of the installed direct tension indicator washers to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. If more than 10 percent of the direct tension indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F959/F959M, test all in place direct tension indicator washers to verify that the ASTM F959/F959M direct tension indicator gaps have been achieved. Test locations must be selected by the Contracting Officer.

3.6.3 High-Strength Bolts

3.6.3.1 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.

3.6.3.2 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.

Inspect calibration of torque wrenches for high-strength bolts.

3.6.3.3 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.

3.6.4 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 --

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SECTION 05 21 00

STEEL JOIST FRAMING

**05/15, CHG 1: 08/18**

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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 | (2018) 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 | (2020) Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders - 45th Edition |
| SJI MANUAL | (2009) 80 Years of Open Web Steel Joist Construction |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1926 | Safety and Health Regulations for Construction |
| 29 CFR 1926.756 | Steel Erection; Beams and Columns |
| 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-AE

SD-03 Product Data

Recycled Content Of Steel Products

SD-05 Design Data

Design Calculations; G-AE

SD-06 Test Reports

Erection Inspection

Welding Inspections

SD-07 Certificates

Certification of Compliance

## 1.3 QUALITY ASSURANCE

Perform all work in compliance with the requirements set forth in 29 CFR 1926.

### 1.3.1 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. Show profiles for nonstandard joist configurations. Show steel joist field splice locations and details.

### 1.3.2 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. SJI MANUAL

b. Steel Joist Institute Member Fabricator

c. 29 CFR 1926

d. 29 CFR 1926.757

e. 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.

1.4 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.

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/360 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 plats 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. Do not prime joists to receive sprayed-on fireproofing. 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 and 29 CFR 1926.756. 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. Place joists on beams in accordance with the joist placement plan. 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 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.

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STEEL DECKS
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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.

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 | (2021a) 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 | (2020) 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, with Change 1, 2022) 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-AE

SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Mechanical Fasteners; G-AE

Touch-Up Paint

Welding Equipment

Welding Rods and Accessories

Recycled Content of Steel Products

SD-04 Samples

Metal Roof Deck Units

Flexible Closure Strips

SD-05 Design Data

Deck Units; G-AE

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

1.3 QUALITY ASSURANCE

1.3.1 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.

1.3.2 Certification of Powder-Actuated Tool Operator

Provide manufacturer's certificate attesting that the operators are authorized to use the low velocity powder-actuated tool.

1.3.3 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. Test specimens shall be made in the presence of Contracting Officer and shall be tested by an approved testing laboratory at the Contractor's expense. 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.

1.3.4 Regulatory Requirements

1.3.4.1 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.

1.3.4.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding a nominal uplift pressure of 60 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.

1.3.5 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.

## 1.4 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.

## 1.5 DESIGN REQUIREMENTS FOR ROOF DECKS

### 1.5.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of AISI D100.

### 1.5.2 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. Furnish sample of Metal Roof Deck Units used to illustrate actual cross section dimensions and configurations.

### 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 The steel design thickness required by the design drawings. Zinc-coat in conformance with ASTM A653/A653M, G90 coating class.

### 2.1.3 Form Deck

Conform to ASTM A653/A653M or ASTM A1008/A1008M for deck used as formwork

for concrete. Fabricate form deck of the steel design thickness required by the design drawings. Zinc-coat in conformance with ASTM A653/A653M, Z275 G90 coating class.

Provide sufficient welds, forming the steel sheets into the cellular floor deck unit, to develop the full horizontal shear at the plane where the steel sheets are joined.

Cellular metal floor deck units must be fluted section cells combined on a flat plate having interlocking type sidelaps. Provide depth, width of unit, number of cells per unit, and width of cells as indicated.

Use panels of maximum possible lengths to minimize end laps. Fabricate deck units in lengths to span 3 or more supports with flush, telescoped, or nested 2 inch laps at ends, and interlocking, or nested side laps, unless otherwise indicated.

2.1.4 Length of Deck Units

Provide deck units of sufficient length to span three or more spacings where possible.

2.1.5 Shop Priming

Shop prime accessories and underside of deck at the factory after coating. Clean surfaces in accordance with the manufacturer's standard procedure followed by a spray, dip or roller coat of rust-inhibitive primer, oven cured.

2.1.6 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.

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 gagethick before galvanizing. Provide 6 inch wide cover plates and form to match the contour of the floor deck units.

2.2.8 Roof Sump Pans

Sump pans must be provided for roof drains and must be minimum 0.075 inch thick steel. Shape sump pans to meet roof slope by the supplier or by a sheet metal specialist. Provide bearing flanges of sump pans to overlap

steel deck a minimum of 3 inch. Shape, size, and reinforce the opening in bottom of the sump pan to receive roof drain.

2.2.9 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.10 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

2.2.11 Hanger

It is not permitted to hang utility systems and suspended ceilings directly from metal deck.

2.2.12 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.

2.2.13 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.

2.2.14 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.

2.2.15 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.

2.2.16 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.

2.2.17 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.

2.2.18 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 NC, 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. 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 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. 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. 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.

3.2.1.2 Mechanical Fastening

Anchor deck to structural supports and adjoining units with mechanical fasteners to comply with the manufacturer's recommendations.

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 lateral load resisting 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.

3.2.5.4 Cover Plates

Where concrete leakage would be a problem, provide metal cover plates, or joint tape, at joints between decking sheets, cellular or noncellular, to be covered with concrete fill.

3.2.5.5 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.

3.2.5.6 Access Hole Covers

Provide access whole covers to seal holes cut in decking to facilitate welding of the deck to structural supports.

3.2.5.7 Hangers

It is not permitted to hang utility systems and suspended ceilings directly from metal deck.

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 or ANSI/SDI NC.

3.2.7 Preparation of Fire-Proofed Surfaces

Provide deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, galvanized and free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Complete any required cleaning prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

3.3 ROOF SUMP PANS

Place sump pans over openings in roof decking and fusion welded to top surface of roof decking. Do not exceed spacing of welds of 12 inch with not less than one weld at each corner. Field cut opening in the bottom of each roof sump pan to receive the roof drain as part of the work of this section.

3.4 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.

3.5 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.

3.6 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.

3.7 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.

3.8 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.9 FIELD QUALITY CONTROL

3.9.1 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.

3.9.2 Deck Weld Inspection

Visual inspect welds in accordance with AWS D1.3/D1.3M.

3.9.3 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 --

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COLD-FORMED METAL FRAMING

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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 | (2021) 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 | (2022) Standard Test Methods for Strength of Anchors in Concrete 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 | (2018) International Building Code |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-301-01 | (2019, with Change 1, 2022) 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-AE

SD-03 Product Data

Steel Studs, Joists, Tracks, Bracing, Bridging and Accessories

Recycled Content of Steel Products

SD-05 Design Data

Metal Framing Calculations; G-AE

SD-07 Certificates

Load-Bearing Cold-Formed Metal Framing

Welds

1.3 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".

1.4 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.

1.5 MAXIMUM DEFLECTION

Deflections of structural members shall not exceed the more restrictive of the limitations of ICC IBC and UFC 3-301-01.

1.6 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".

1.6.1 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.

1.6.2 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: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90).

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: 0.0329 inch.

(2) Flange Width: 1-3/8 inches minimum.

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: 1-1/4 inches.

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, G60.

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 36; 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.

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.

3.2 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:

| LOAD | HEIGHT | BRACING |
|---|---|---|
| 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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DIVISION 05 - METALS

SECTION 05 50 13

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**05/17, CHG 1: 08/18**

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-- End of Section Table of Contents --

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS
**05/17, 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.

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

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 | (2022) Nuts for General Applications: Machine Screw Nuts, and 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 |

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; 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 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 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 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 A467/A467M | (2020) Standard Specification for Machine Coil Chain |
| 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 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 C1513 | (2018) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections |
| ASTM D1187/D1187M | (1997; E 2011; R 2011) Asphalt-Base Emulsions for Use as Protective Coatings for Metal |
| ASTM F1554 | (2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength |

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. 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-02 Shop Drawings

Cover Plates and Frames, Installation Drawings; G-AE

Bollards/Pipe Guards; G-AE

Embedded Angles and Plates, Installation Drawings; G-AE

SD-03 Product Data

Corner Guards

Cover Plates and Frames; G-AE

Recycled Content

## 1.3 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.

## 1.4 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.

## 1.5 MISCELLANEOUS REQUIREMENTS

### 1.5.1 Fabrication Drawings

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

### 1.5.2 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.

## 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.

### 2.2.1 Structural Carbon Steel

Provide in accordance with ASTM A36/A36M.

### 2.2.2 Structural Tubing

Provide in accordance with ASTM A500/A500M.

### 2.2.3 Steel Pipe

Provide in accordance with ASTM A53/A53M, Type E or S, Grade B.

### 2.2.4 Fittings for Steel Pipe

Provide standard malleable iron fittings in accordance with ASTM A47/A47M.

### 2.2.5 Anchor Bolts

Provide in accordance with ASTM F1554. Where exposed, provide anchor bolts of the same material, color, and finish as the metal to which they are applied.

#### 2.2.5.1 Adhesive Anchors

Provide anchors as indicated on the Structural Drawings.

2.2.5.2 Lag Screws and Bolts

Provide in accordance with ASME B18.2.1, type and grade best suited for the purpose.

2.2.5.3 Toggle Bolts

Provide in accordance with ASME B18.2.1.

2.2.5.4 Bolts, Nuts, Studs and Rivets

Provide in accordance with ASME B18.2.2 or ASTM A307.

2.2.5.5 Powder Actuated Fasteners

Follow safety provisions in accordance with ASSP A10.3.

2.2.5.6 Screws

Provide in accordance with ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.2.5.7 Washers

Provide plain washers in accordance with ASME B18.22M, ASME B18.21.1. 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.

2.2.5.8 Welded Headed Shear Studs

Provide in accordance with ASTM A108 or ASTM A29/A29M-12.

2.2.6 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 Shop Cleaning and Painting

2.3.1.1 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. 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.

2.3.1.2 Pretreatment, Priming and Painting

Apply pre-treatment, primer, and paint in accordance with manufacturer's

printed instructions.

2.3.2 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.3.3 Aluminum Surfaces

2.3.3.1 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.

2.3.3.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF45. Unless otherwise specified, provide all other aluminum items with a anodized 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 AA DAF45. Provide a polished satin finish on items to be anodized.

2.4 CORNER GUARDS

Provide interior corner guards as indicated in Section 10 26 00 WALL AND DOOR PROTECTION.

2.5 COVER PLATES AND FRAMES

Fabricate cover plates of 1/4 inch thick rolled steel weighing not more than 100 pounds per plate with a slip-resistant, carbon steel in accordance with ASTM A283/A283M. Provide aluminum oxide or silicon carbide on wearing surfaces. Provide galvanized plate. Reinforce to sustain a live load as indicated on the Structural Drawings. 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 1/8 inch clearance at edges and between cover plates.

2.6 BOLLARDS/PIPE GUARDS

Provide extra strong weight steel pipe as indicated on drawings and in accordance with ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.7 MISCELLANEOUS PLATES AND SHAPES

Provide items that do not form a part of the structural steel framework, such as lintels, sill angles, and miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and welds. Construct to have at least 8 in bearing on masonry at each end.

Provide angles and plates in accordance with ASTM A36/A36M, for embedment as indicated. Galvanize embedded items exposed to the elements in accordance with ASTM A123/A123M.

## 2.8 SAFETY CHAINS

Construct safety chains of galvanized steel, straight link type, minimum 3/16 inch diameter, with a minimum of twelve 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 galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area.

## 2.9 SECURITY GRILLES

Fabricate of channel frames with not less than two masonry anchors at each jamb and 1/2 inch hardened steel bars spaced not over 4 inches both ways and welded to frame. Provide 18 by 16 mesh screen and two layers of 1/4 inch hardware cloth clamped to frame.

# 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 countersuck rivets where exposed. 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, expansion shields, powder-driven fasteners, toggle bolts (when approved for concrete), through bolts for masonry, 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 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.

## 3.9 INSTALLATION OF BOLLARDS/PIPE GUARDS

Set bollards/pipe guards vertically in concrete piers. Fill hollow cores with concrete having a compressive strength of 3000 psi.

## 3.10 MOUNTING OF SAFETY CHAINS

Provide safety chains where indicated. Mount the top chain 3 feet 6 inches above the floor and mount the lower chain 2 feet above the floor.

## 3.11 INSTALLATION MISCELLANEOUS PLATES AND SHAPES

Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and welds. Construct to have at least 8 inches bearing on masonry at each end.

-- 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 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 A6/A6M | (2021) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling |
| ASTM A27/A27M | (2020) Standard Specification for Steel Castings, Carbon, for General Application |
| 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 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 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 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 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 |

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531 (2017) Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2021) Life Safety 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

Iron and Steel Hardware; G-AE

Steel Shapes, Plates, Bars, and Strips; G-AE

Metal Stair System; G-AE

SD-03 Product Data

Structural Steel Plates, Shapes, and Bars; G-AE

Structural Steel Tubing; G-AE

Hot-Rolled Carbon Steel Sheets and Strips; G-AE

Cold-Finished Steel Bars; G-AE

Hot-Rolled Carbon Steel Bars; G-AE

Cold-Rolled Carbon Steel Sheets; G-AE

Concrete Inserts; G-AE

Protective Coating; G-AE

Steel Pan Stairs; G-AE

Steel Stairs; G-AE

SD-07 Certificates

Welding Procedures; G-RO

Welder Qualification; G-RO

SD-08 Manufacturer's Instructions

Structural Steel Plates, Shapes, and Bars; G-RO

Structural Steel Tubing; G-RO

Hot-Rolled Carbon Steel Sheets and Strips; G-RO

Cold-Finished Steel Bars; G-RO

Hot-Rolled Carbon Steel Bars; G-RO

Cold-Rolled Carbon Steel Sheets; G-RO

Protective Coating; G-RO

1.3 QUALITY CONTROL

1.3.1 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

Submit complete and detailed fabrication drawings for all iron and steel hardware, and for all steel shapes, plates, bars, and strips used in accordance with the design specifications referenced in this section.

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 Metal Safety Nosings

Between stringers, provide abrasive cast metal safety nosings, 4 inches wide by the full length of the step. Fabricate nosings to the thickness, profile, and surface pattern indicated. Equip each nosing with integral anchors for embedding in the pan fill material, and space the anchors not more than 4 inches from each end and not more than 15 inches on center.

2.2.2.5 Safety Nosings for Concrete Treads

Provide safety nosings of cast aluminum with cross-hatched abrasive surfaces, or extruded aluminum with abrasive inserts, at least 4 inches wide and 1/4 inch thick and terminating at not more than 6 inches from the ends of treads for metal-pan cement-filled treads extending the full length of the tread for stairs and for platforms and landings. Provide safety nosings with anchors embedded a minimum of 3/4 inch in the concrete and with tops flush with the top of the traffic surface.

2.2.2.6 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 Floor Grating Treads and Platforms

Provide floor grating treads and platforms conforming to ASTM A6/A6M, ASTM A29/A29M and NAAMM MBG 531, "Metal Bar Grating Manual." Provide the pattern, spacing, and bar sizes as indicated:

b. Manufacturer's baked-on primer for painted finishes.

Fabricate grating treads with steel plate nosings on one edge and with steel angle or steel plate carriers at each end for string connections. Secure treads to strings with bolts.

Match the nosings of grating platforms with the nosing of grating treads at landings. Provide toeplates where the open-sided edges of floor grating meet platform framing members.

2.2.4 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 grating 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 500 pounds per

square foot, or a concentrated load of 1000 pounds 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. Supportmetal pan for concrete fill and steel grating 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 Concrete Inserts

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, and hot-dip-galvanized in accordance with ASTM A153/A153M.

Wedge-type concrete inserts consisting of galvanized box-type ferrous castings designed to accept 3/4-inch diameter bolts having special wedge-shaped heads; 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.

Carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims and galvanized in accordance with ASTM A153/A153M. Provide slotted-type concrete inserts consisting of galvanized 1/8-inch thick pressed steel plate conforming to ASTM A283/A283M; of box-type welded construction with slot designed to receive 3/4-inch diameter square-head bolt with knockout cover; and be hot-dip-galvanized in accordance with ASTM A123/A123M.

2.3.3 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 B, 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 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 Safety Nosings

Completely embed nosing in concrete before the initial set of the concrete occurs and finish flush with the top of the concrete surface.

#### 3.2.4 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.

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SECTION 05 51 33

METAL LADDERS

**02/16, CHG 2: 02/18**

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METAL LADDERS
**02/16, 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 DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

AMERICAN LADDER INSTITUTE (ALI)

| | |
|---|---|
| ALI A14.3 | (2008; R 2018) Ladders - Fixed - Safety Requirements |

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

| | |
|---|---|
| ASSP Z359.16 | (2016) Safety Requirements for Climbing Ladder Fall Arrest Systems |

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 |
| 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 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 |

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 |
| 29 CFR 1910.28 | (Nov 2016)Duty to Have Fall Protection and Falling Object Protection |
| 29 CFR 1910.29 | (Nov 2016) Fall Protection System and Falling Object Protection - Criteria and Practices |

## 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

Ladders, Installation Drawings; G-AE

SD-03 Product Data

Ladders;G-AE

Ladder Safety Devices (Climbing Ladder Fall Arrest Systems); G-AE

SD-07 Certificates

Fabricator Certification for Ladder Assembly

Fabricator Certification for Ships Ladder Assembly

## 1.3 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.

Provide fabricator certification for ships ladder assembly stating that the ships ladder and associated components have been fabricated according to the requirements of 29 CFR 1910.23.

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.

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.

2.1.5 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.

2.2 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.

2.2.3 Aluminum Surfaces

2.2.3.1 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.

2.2.3.2 Aluminum Finishes

Unexposed plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF45. Unless otherwise specified, provide all other aluminum items with standard mill 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 in AA DAF45.

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 and 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. The drawings must indicate ladder locations and details of critical dimensions and materials.

2.3.1 Phasing out of Ladder Cages and Wells (29 CFR 1910.28, Nov 2016)

Conform to 29 CFR 1910.28 (Nov 2016).
Each newly installed ladder over 15 feet in length shall only be equipped

with a personal fall arrest system or climbing ladder fall arrest system (ladder safety device), cages and wells are prohibited. When a fixed ladder, cage, or well, or any portion of a section thereof, is replaced, a personal fall arrest system or climbing ladder fall arrest system (ladder safety device) is installed in at least that section of the fixed ladder, cage, or well where the replacement is located. On and after November 18, 2036, all fixed ladders shall only be equipped with a personal fall arrest system or a ladder safety device (climbing ladder Fall Arrest System).

2.3.2 Ladder Safety Devices (Climbing Ladder Fall Arrest Systems)

Conform to 29 CFR 1910.29, Section 7 of ALI A14.3 and ASSP Z359.16. Install ladder safety devices on ladders over 15 feet long or more. The ladder safety systems must meet the design requirement of the ladders which they serve. The ladder safety system must be capable of sustaining a minimum static load of 1,000 pounds. The applied loads transferred to the climbing ladder mounting locations as a result of a fall shall be specified by the manufacturer of the climbing ladder fall arrest system. Each ladder safety system must allow the worker to climb up and down using both hands and does not require the employee continuously, hold, push, or pull any part of the system while climbing. The connection between the carrier or lifeline and the point of attachment to the body harness does not exceed 9 inches. The ladder safety system consists of a rigid or flexible carrier. Mountings for the rigid carries are attached at each end of the carrier, with intermediate mountings spaced as necessary, along the entire length of the carrier. Mountings for flexible carrier are attached at each end of the carrier and cable guides for flexible carriers are installed at least 25 feet apart but not more than 40 feet apart along the entire length of the carrier. The design and installation of mountings and cable guides does not reduce the design strength of the ladder.

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. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D1187/D1187M, asphalt-base emulsion.

### 3.5.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, must be free of rust, grease, dirt and other foreign matter.

### 3.5.3 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

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SECTION 05 52 00

METAL RAILINGS
**02/18, 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.

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 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 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 A467/A467M | (2020) Standard Specification for Machine Coil Chain |
| ASTM A500/A500M | (2021a) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes |
| ASTM A575 | (2020) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades |

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

| | |
|---|---|
| NAAMM AMP 521 | (2001; R 2012) Pipe Railing Systems Manual |

## 1.2 ADMINISTRATIVE REQUIREMENTS

### 1.2.1 Preinstallation Meetings

Within 30 days of contract award, submit fabrication drawings to the Contracting Officer for the following items:

a. Iron and steel hardware

b. Steel shapes, plates, bars and strips

c. Steel 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. Structural-steel plates, shapes, and bars

b. Structural-steel tubing

c. Cold-finished steel bars

d. Hot-rolled carbon steel bars

e. Concrete inserts

f. Protective coating

g. Steel railings and handrails

h. 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-AE

Iron and Steel Hardware; G-AE

Steel Shapes, Plates, Bars and Strips; G-AE

SD-03 Product Data

Structural-Steel Plates, Shapes, and Bars; G-AE

Structural-Steel Tubing; G-AE

Cold-Finished Steel Bars; G-AE

Hot-Rolled Carbon Steel Bars; G-AE

Concrete Inserts; G-AE

Protective Coating; G-AE

Steel Railings and Handrails; G-AE

Anchorage and Fastening Systems; G-AE

SD-07 Certificates

Welding Procedures; G-RO

Welder Qualification; G-RO

SD-08 Manufacturer's Instructions

Installation Instructions

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.

## PART 2 PRODUCTS

### 2.1 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.

2.1.1 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.

Provide removable sections as indicated.

2.1.2 Protective Coating

Shop-prime the steelwork as indicated in accordance with Section 09 90 00 PAINTS AND COATINGS except the following:

a. steel surfaces encased in concrete

b. steel surfaces for welding

c. high-strength bolt-connected contact surfaces

2.2 COMPONENTS

2.2.1 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.

2.2.2 Structural-Steel Tubing

Provide structural-steel tubing, hot-formed, welded or seamless, conforming to ASTM A500/A500M, Grade B, unless otherwise noted.

2.2.3 Hot-Rolled Carbon Steel Bars

Provide bars and bar-size shapes conforming to ASTM A575, grade as selected by the fabricator.

2.2.4 Cold-Finished Steel Bars

Provide cold-finished steel bars conforming to ASTM A108, grade as selected by the fabricator.

2.2.5 Steel Pipe

Provide pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.2.6 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.

2.2.7 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.

2.2.8 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.

2.2.8.1 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.

Provide kickplates between railing posts where indicated, and consisting of 1/8 inch steel flat bars not less than 6 inches high. Secure kickplates as indicated.

2.2.9 Safety Chains

Provide safety chains of galvanized steel, straight-link type, 3/16 inch diameter, with at least 12 links per foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A467/A467M, Class CS. Provide snap hooks of boat type. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Locate safety chain where indicated. Mount the top chain 3 feet 6 inches above the floor and mount the lower chain 2 feet above the floor.

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 ora 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.

b. For hollow masonry and stud partition anchorage, use toggle bolts having square heads.

Install toe boards and brackets where indicated. Make splices, where required, at expansion joints. Install removable sections as indicated.

## 3.2 INSTALLATION

Submit manufacturer's installation instructions for the following products to be used in the fabrication of steel stair railing and hand rail work:

a. Structural-steel plates, shapes, and bars

b. Structural-steel tubing

c. Cold-finished steel bars

d. Hot-rolled carbon steel bars

e. Protective coating

f. Steel railings and handrails

g. Anchorage and fastening systems

Provide complete, detailed fabrication and installation drawings for all iron and steel hardware, and for all steel shapes, plates, bars, and strips used in accordance with the design specifications cited in this section.

### 3.2.1 Steel Handrail

Install handrail in pipe sleeves embedded in concrete and filled with nonshrink grout or quick-setting anchoring cement with anchorage covered with standard pipe collar pinned to post. or by means of base plates bolted to stringers or structural-steel frame work. Secure rail ends by steel pipe flanges anchored by expansion shields and bolts or through-bolted to a back plate or by 1/4 inch lag bolts to studs or solid backing.

### 3.2.2 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.

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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.

AMERICAN FOREST FOUNDATION (AFF)

| | |
|---|---|
| ATFS STANDARDS | (2015) American Tree Farm System Standards of Sustainability 2015-2020 |

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

| | |
|---|---|
| ALSC PS 20 | (2015) American Softwood Lumber Standard |

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 | (2022) Nuts for General Applications: Machine Screw Nuts, and 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 M6 | (2013) Brands Used on Preservative Treated Materials |
| AWPA P49 | (2015; R 2021) Standard for Fire Retardant FR-1 |
| AWPA T1 | (2022) Use Category System: Processing and Treatment Standard |

| | |
|---|---|
| AWPA U1 | (2022) 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 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 |

CSA GROUP (CSA)

| | |
|---|---|
| CSA Z809-08 | (R2013) Sustainable Forest Management |

FOREST STEWARDSHIP COUNCIL (FSC)

| | |
|---|---|
| FSC STD 01 001 | (2015) Principles and Criteria for Forest Stewardship |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IBC | (2018) International Building Code |

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)

| | |
|---|---|
| PEFC ST 2002:2013 | (2015) PEFC International Standard Chain of Custody of Forest Based Products Requirements |

SUSTAINABLE FOREST INITIATIVE (SFI)

| | |
|---|---|
| SFI 2015-2019 | (2015) Standards, Rules for Label Use, |

Procedures and Guidance

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) |

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

Nailers; G-AE

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;G-AE

Adhesives;G-AE

SD-07 Certificates

Certificates of Grade; G-RO

Certified Sustainably Harvested Virgin Lumber

Certified Sustainably Harvested Plywood for Other Uses

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 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.

### 1.4.4 Hardboard, Gypsum Board, and Fiberboard

Mark each sheet or bundle to identify the standard under which the material is produced and the producer.

## 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 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. Blocking in interior walls and partitions.

b. Plywood baking panels for interiors.

## 1.8 ENVIRONMENTAL REQUIREMENTS

During and immediately after installation of treated wood, engineered wood products, and laminated wood products at interior spaces, provide temporary ventilation.

## 1.9 CERTIFICATIONS

### 1.9.1 Certified Wood Grades

Provide certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

### 1.9.2 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08, SFI 2015-2019, or other third party program certified by PEFC ST 2002:2013. Provide a letter of Certification of Sustainably Harvested Wood signed by the wood supplier. Identify certifying organization and their third party program name and indicate compliance with chain-of-custody program requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Submit copies of invoices bearing certification numbers.

### 1.9.3 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

#### 1.9.3.1 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.

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 PLYWOOD AND STRUCTURAL-USE PANELS

APA L870, APA S350, APA E445, and APA F405 respectively.

2.2.1 Other Uses

2.2.1.1 Plywood

Plywood for backing panels. C-D Grade, Exposure 1. Provide certified sustainably harvested plywood for other uses.

2.3 OTHER MATERIALS

2.3.1 Miscellaneous Wood Members

2.3.1.1 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. |

2.3.1.2 Blocking

Blocking must be standard or number 2 grade.

2.3.2 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials and as specified.

2.4 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.

2.4.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

2.4.2 Anchor Bolts

ASTM A307, size as indicated, complete with nuts and washers.

2.4.3 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.

2.4.4 Lag Screws and Lag Bolts

ASME B18.2.1.

2.4.5 Wood Screws

ASME B18.6.1.

2.4.6 Nails

ASTM F547, size and type best suited for purpose. 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.

## 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. Space plastic lumber boards as necessary to allow for lengthwise expansion and contraction. 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. Install plastic lumber with screws or bolts; if nails are used, use ring shank or spiral shank nails. 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.

### 3.2 MISCELLANEOUS

#### 3.2.1 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.

### 3.3 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 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. Do not burn scrap lumber that

has been pressure treated, or lumber that is less than one year old.

-- End of Section --

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DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

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PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

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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 D1037 | (2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials |
| ASTM F547 | (2017) Standard Terminology of Nails for Use with Wood and Wood-Base Materials |

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

| | |
|---|---|
| ANSI/BHMA A156.9 | (2020) Cabinet Hardware |

COMPOSITE PANEL ASSOCIATION (CPA)

| | |
|---|---|
| CPA A208.1 | (2016) Particleboard |
| CPA A208.2 | (2016) Medium Density Fiberboard (MDF) for Interior Applications |

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 vanities 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. Sand smooth and apply a clear finish of polyurethane to all exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule. Wood finish may be shop finished or field applied in accordance with Section 09 90 00 PAINTS AND COATINGS.

1.3 SUSTAINABILITY REPORTING

Materials in this technical specification may contribute towards contract compliance with sustainability requirements. See Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING for project.

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

Shop Drawings; G-AE
Installation

SD-03 Product Data

Wood Materials
Finish Schedule
Certification

SD-04 Samples

Plastic Laminates; G-AE
Cabinet Hardware; G-AE

SD-07 Certificates

Quality Assurance
Laminate Clad Casework

1.5 QUALITY ASSURANCE

1.5.1 General Requirements

Unless otherwise noted on the drawings, furnish all materials, construction methods, and fabrication conforming to and complying with the custom grade quality standards as outlined in NAAWS 3.1, Section for laminate clad cabinets. These standards apply in lieu of omissions or

specific requirements in this specification. Contractors and their personnel engaged in the work must 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 must also certify a minimum of ten years Contractor's experience in laminate clad casework fabrication and construction. Provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity in the quality control statement.

1.5.2 Sustainable Design Certification

Product must be third party certified in accordance with ULE Greenguard Gold, SCS Scientific Certification Systems Indoor Advantage Gold or equal. Perform certification annually and keep current.

1.6 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. Ventilate the storage area and do not subject to extreme changes in temperature or humidity.

1.7 SEQUENCING AND SCHEDULING

Coordinate work with other trades. Do not install units in any room or space until painting, and ceiling installation are complete within the room where the units are located. Install floor cabinets before finished flooring materials are installed.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

a. Provide kiln-dried Grade III framing lumber to dimensions as shown on the drawings. Frame front, where indicated on the drawings, must be nominal 3/4 inch hardwood.

2.1.2 Panel Products

2.1.2.1 Plywood

Use veneer core hardwood plywood, NAAWS 3.1 Grade AA panels for framing purposes. Indicate nominal thickness of plywood panels in this specification and on the drawings.

2.1.2.2 Particleboard

Provide industrial grade, medium density ( 40 to 50 pounds per cubic foot ), 3/4 inch thick particleboard. Use a moisture-resistant particleboard in grade Type 2-M-2 or 2-M-3 as the substrate for plastic laminate covered components as located on the drawings and other areas subjected to moisture. Provide particleboard meeting the minimum standards listed in ASTM D1037 and CPA A208.1.

#### 2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) must be an acceptable panel substrate where noted on the drawings. Provide medium density fiberboard meeting the minimum standards listed in CPA A208.2.

### 2.2 SOLID POLYMER MATERIAL

Provide solid surfacing casework components in conformance to the requirements of Section 06 61 16 SOLID SURFACING FABRICATIONS.

### 2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

Provide plastic laminates meeting the requirements of ANSI/NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Indicate design, colors, surface finish and texture, and locations on the drawings. Submit two samples of each plastic laminate pattern and color. Samples less than 5 by 7 inches in size are not acceptable. Provide plastic laminate types and nominal minimum thicknesses for casework components as indicated in the following paragraphs.

#### 2.3.1 Horizontal General Purpose Standard (HGS) Grade

Provide horizontal general purpose standard grade plastic laminate that is 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 Cabinet Liner Standard (CLS) Grade

Provide cabinet liner standard grade plastic laminate that is 0.020 inches in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

#### 2.3.3 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 must be 0.020 inches. Provide backing sheets for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

### 2.4 EDGE BANDING

Provide PVC vinyl, 0.020 inch thick, edge banding for casework doors and drawer fronts. Material width must be 15/16 inches. Color and pattern must match exposed door and drawer front laminate pattern and color.

### 2.5 CABINET HARDWARE

Submit one sample of each cabinet hardware item specified to include hinges, pulls, drawer glides, and miscellaneous hardware. Provide hardware conforming to ANSI/BHMA A156.9, unless otherwise noted, and consisting of the following components:

2.5.1 Door Hinges

Concealed European type, BHMA No. B01602.

2.5.2 Cabinet Pulls

Wire pulls, 4 inches long, 5/16 inches diameter complying with BHMA B02012.

2.5.3 Drawer Slide

Side mounted, zinc-plated steel drawer slides with steel ball bearings, Grade 1, complying with ANSI/BHMA A156.9 with full extension and a minimum 75 pound load capacity. Include an integral stop to avoid accidental drawer removal.

2.5.4 Adjustable Shelf Support System

Recessed (mortised) metal standards, BHMA No. BO4071, finish: stainless steel. Support clips for the standards must be closed type, BHMA No. B04081, finish: stainless steel. .

2.6 FASTENERS

Provide nails, screws, and other suitable fasteners that are the size and type best suited for the purpose and conforming to ASTM F547 where applicable.

2.7 ADHESIVES, CAULKS, AND SEALANTS

2.7.1 Adhesives

Use formula and type of adhesives recommended by AWI. Select adhesives for their ability to provide a durable, permanent bond and take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Meet local regulations regarding VOC emissions and off-gassing.

2.7.1.1 Wood Joinery

Use Type II for interior use polyvinyl acetate resin emulsion adhesives to bond wood members. Adhesives must withstand a bond test as described in ANSI/WDMA I.S.1A.

2.7.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood must be adhesive consistent with AWI and laminate manufacturer's recommendations. Adhere PVC edgebanding using a polymer-based hot melt glue.

2.7.2 Caulk

Use clear, 100 percent silicone caulk to fill voids and joints between laminated components and between laminated components and adjacent surfaces.

2.7.3 Sealant

Use sealant 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.

2.8 FABRICATION

Verify field measurements as indicated in the shop drawings before fabrication. Accomplish fabrication and assembly of components at the shop site to the maximum extent possible. Meet or exceed the requirements for AWI custom grade unless otherwise indicated in this specification. Make cabinet style, in accordance with NAAWS 3.1, Section 400-G descriptions, as indicated on the drawings.

2.8.1 Base and Wall Cabinet Case Body

2.8.1.1 Cabinet Components

Use frame members that are glued-together, kiln-dried hardwood lumber. Brace top corners, bottom corners, and cabinet bottoms with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Construct cabinet components from the following materials and thicknesses:

2.8.1.1.1 Body Members (Ends, Divisions, Bottoms, and Tops)

3/4 inch medium density fiberboard (MDF) panel product

2.8.1.1.2 Face Frames and Rails

3/4 inch hardwood lumber

2.8.1.1.3 Shelving

3/4 inch medium density fiberboard (MDF) panel product

2.8.1.1.4 Cabinet Backs

1/4 inch medium density fiberboard (MDF) panel product

2.8.1.1.5 Drawer Sides, Backs, and Subfronts

1/2 inch hardwood lumber

2.8.1.1.6 Drawer Bottoms

1/4 inch medium density fiberboard (MDF) panel product

2.8.1.1.7 Door and Drawer Fronts

3/4-inch medium density fiberboard (MDF) panel product

2.8.1.2 Joinery Method for Case Body Members

2.8.1.2.1 Tops, Exposed Ends, and Bottoms

a. Steel "European" assembly screws ( 1-1/2 inch from end, 5 inch on center, fasteners will not be visible on exposed parts).

b. Doweled, glued under pressure (approx. 4 dowels per 12 inches of joint).

c. Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).

d. Spline or biscuit, glued under pressure.

2.8.1.2.2 Exposed End Corner and Face Frame Attachment

2.8.1.2.2.1 Mitered Joint

lock miter or spline or biscuit, glued under pressure (no visible fasteners)

2.8.1.2.2.2 Non-Mitered Joint (90 degree)

butt joint glued under pressure (no visible fasteners)

2.8.1.2.2.3 Butt Joint

glued and nailed

2.8.1.2.3 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. Use the following fabrication method:

2.8.1.2.3.1 Full Bound

Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets must be side bound, captured in grooves; glued and fastened to top and bottom.

2.8.1.2.3.2 Side Bound

Side bound, captured in groove or rabbetts; glued and fastened.

2.8.1.2.4 Cabinet Backs (Floor Standing Cabinets)

2.8.1.2.4.1 Side Bound

Side bound, captured in grooves; glued and fastened to top and bottom.

2.8.1.2.4.2 Side Bound with Rabbetts

Side bound, placed in rabbetts; glued and fastened in rabbetts.

2.8.1.2.5 Wall Anchor Strips

Wall Anchor Strips are required for all cabinets with backs less than 1/2 inch thick. Use strips consisting of minimum 1/2 inch thick lumber, minimum 2-1/2 inches width; securely attache to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.8.2 Cabinet Floor Base

Mount floor cabinets on a base constructed of 3/4 inch veneer core exterior plywood. Provide base assembly components that are treated lumber.

Make finished height for each cabinet base no less than the full height of the installed, specified wall base as indicated on the drawings. Make bottom edge of the cabinet door or drawer face extend below the top of the base as indicated on the drawings.

2.8.3 Cabinet Door and Drawer Fronts

Fabricate door and drawer fronts from 3/4 inch medium density fiberboard (MDF. Surface all door and drawer front edges with PVC edgebanding, color and pattern to match exterior face laminate.

2.8.4 Drawer Assembly

2.8.4.1 Drawer Components

Provide drawer components consisting of a removable drawer front, sides, backs, and bottom. Construct drawer components of the following materials and thicknesses:

2.8.4.1.1 Drawer Sides and Backs For Laminate Finish

1/2 inch thick 7-ply hardwood veneer core substrate

2.8.4.1.2 Drawer Sides and Back For Thermoset Decorative Overlay (Melamine) Finish

1/2 inch thick medium density particleboard or MDF fiberboard substrate

2.8.4.1.3 Drawer Bottom

1/4 inch thick veneer core panel product for transparent or plastic laminate finish

2.8.4.2 Drawer Assembly Joinery Method

a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.

b. Doweled, glued under pressure.

c. Lock shoulder, glued and pin nailed.

d. Set bottoms into sides, front, and back, 1/4 inch deep groove with a minimum 3/8 inch standing shoulder.

2.8.5 Shelving

2.8.5.1 General Requirements

Fabricate shelving from 3/4 inch medium density fiberboard (MDF. Finish all shelving top and bottom surfaces with HPDL plastic laminate. Finish shelf edges in a PVC edgebanding.

2.8.5.2 Shelf Support System

The shelf support system is as follows:

2.8.5.2.1 Recessed (Mortised) Metal Shelf Standards

Mortise standards flush with the finishes surface of the cabinet interior side walls, two per side. Pposition 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.

2.8.6 Laminate Application

Apply laminate to substrates following 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. Machined flush, file, sand, or buff all laminate edges to remove machine marks and ease (sharp corners removed). Clean up at easing must be such that no overlap of the member eased is visible. Perform fabrication in conformance to ANSI A161.2. Provide laminate types and grades for component surfaces as follows unless otherwise indicated on the drawings:

2.8.6.1 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.

2.8.6.2 Adjustable Shelving

2.8.6.2.1 Top and Bottom Surfaces

HPDL Grade HGS

2.8.6.2.2 All Edges

PVC edgebanding

2.8.6.3 Fixed Shelving

2.8.6.3.1 Top and Bottom Surfaces

HPDL Grade HGS

2.8.6.3.2 Exposed Edges

PVC edgebanding

2.8.6.4 Door, Drawer Fronts, Access Panels

2.8.6.4.1 Exterior (Exposed) and Interior (Semi-Exposed) Faces

HPDL Grade VGS

2.8.6.4.2 Edges

PVC edgebanding

2.8.6.5 Drawer Assembly

All interior and exterior surfaces: HPDL Grade CLS.

2.8.6.6 Tolerances

Meet the NAAWS 3.1 custom grade requirements for flushness, flatness, and joint tolerances of laminated surfaces.

2.8.7 Finishing

2.8.7.1 Filling

Do not expose fasteners on laminated surfaces. Make all nails, screws, and other fasteners in non-laminated cabinet components countersunk and fill the holes with wood filler consistent in color with the wood species.

2.8.7.2 Sanding

Prepare all surfaces requiring coatings by sanding with a grit and in a manner that scratches will not show in the final system.

2.8.7.3 Coatings

Types, method of application and location of casework finishes must be in accordance with the finish schedule, drawings and Section 09 90 00 PAINTS AND COATINGS. Paint all cabinet reveals. 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. 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 must 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 must comply with applicable requirements for NAAWS 3.1 custom quality standards. Install countertops and fabricated assemblies level, plumb, and true to line, in locations shown on the drawings. Attach and securely anchor cabinets and other laminate clad casework assemblies 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

Utilize a floor anchoring system as detailed on the drawings for base

cabinets. Anchoring and mechanical fasteners must not be visible from the finished side of the casework assembly. Attach cabinet assemblies to anchored bases without visible fasteners as indicated in the drawings. Where assembly abuts a wall surface, 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

Utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width to wall mount cabinet; securely attach to the wall side of the cabinet back, both top and bottom.

3.1.2 Hardware

Install casework hardware in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, use plastic or synthetic insertion dowels to receive 3/16 inch "Euroscrews". The use of wood screws without insertion dowels is prohibited.

3.1.3 Doors, Drawers and Removable Panels

Accomplish the fitting of doors, drawers and removable panels 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 and in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

-- 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; R 2021; E 2021) 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 |

INTERNATIONAL CAST POLYMER ASSOCIATION (ICPA)

| | |
|---|---|
| ICPA SS-1 | (2001) Performance Standard for Solid Surface Materials |

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 counter tops 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-AE

Installation; G-AE

SD-03 Product Data

Solid Polymer; G-AE

Indoor air quality for solid surface seam and sealant products

SD-04 Samples

Material; G-AE

Counter Tops; G-AE

SD-06 Test Reports

Test Report Results

SD-07 Certificates

Qualifications

Indoor Air Quality for solid surface fabrication products

SD-10 Operation and Maintenance Data

Solid Polymer, Data Package 1; G-RO

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.

1.4.2 Mock-ups

Submit Detail Fabrication Drawings indicating locations, dimensions, component sizes, fabrication and joint details, attachment provisions, installation details, and coordination requirements with adjacent work. Prior to final approval of shop drawings, provide a full-size mock-up of a typical counter top where multiple units are required. Include all solid surfacing material components required to provide a completed unit. Utilize finishes in patterns and colors as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers in the mock-up. Should the mock-up not be approved, re-work or remake it until approval is secured. Remove rejected units from the jobsite. Approved mock-up may remain as part of the finished work.

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 and workmanship for a period of 10 years from date of final acceptance of the work.

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.

Submit manufacturers' operations and maintenance data for each type of solid polymer fabrication in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Solid Surfacing Material

Provide solid polymer 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. Horizontal Surfaces: 1/2 inch thick material

b. 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 |

| PROPERTY | REQUIREMENT (min. or max.) | TEST PROCEDURE |
|---|---|---|
| 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 Acrylic-modified Polymer Solid Surfacing Material

Cast, solid polymer material composed of a formulation containing acrylic and polyester polymers, mineral fillers, and pigments. Provide acrylic polymer content not less than 5 percent and not more than 10 percent in order to meet the following minimum performance requirements:

| PROPERTY | REQUIREMENT (min. or max.) | TEST PROCEDURE |
|---|---|---|
| Tensile Strength | 4100 psi (max.) | ASTM D638 |
| Hardness | 50-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 |

| PROPERTY | REQUIREMENT (min. or max.) | TEST PROCEDURE |
|---|---|---|
| 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.) | 0.6 percent max. | ASTM D570 |
| Flammability | | ASTM E84 |
| Flame Spread | 25 max. | |
| Smoke Developed | 100 max. | |
| Sanitation | "Food Contact" approval | NSF/ANSI 51 |
| Flexural Strength | 6,800 psi (min.) | ASTM D790 |

2.1.4 Material Patterns and Colors

Provide pattern and color for all solid surfacing material components and fabrications as indicated on drawings; 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.

2.1.5 Surface Finish

Provide a uniform appearance on exposed finished surfaces and edges. Exposed surface finish is semigloss; gloss rating of 25-50.

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 Conductive Tape

Provide manufacturer's standard conductive foil tape, 4 mils thick, applied around the edges of cut outs containing hot or cold appliances.

2.2.5 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, sealants, and heat reflective tape. Both the manufacturer of materials and the fabricator are required to submit a detailed description of 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.

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 4 inches high. Provide backsplashes and end splashes for all counter tops. 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 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. Provide counter tops with 4 inch high loose backsplash and loose endsplashes at all locations. 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.

2.3.4.1 Counter Tops with Sinks

a. Provide sink, faucet, and plumbing requirements in accordance with Section 22 00 00 PLUMBING,GENERAL PURPOSE.

2.3.4.2 Counter Tops with Bowls

a. 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 --

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**11/11, CHG 4: 08/18**

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SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION
**11/11, CHG 4: 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 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 D3575 | (2020) Flexible Cellular Materials Made From Olefin Polymers |
| 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 |

GREEN SEAL (GS)

| | |
|---|---|
| GS-36 | (2013) Adhesives for Commercial Use |

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 |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.134 | Respiratory Protection |

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-03 Product Data

Sound-Attenuation Blanket Insulation; G-AE

Recycled Content for Insulation Materials

Sill Sealer Insulation; G-AE

Accessories

SD-07 Certificates

Indoor Air Quality for Insulation Materials

Indoor Air Quality for Adhesives

SD-08 Manufacturer's Instructions

Insulation

1.3 CERTIFICATIONS

Submit required indoor air quality certifications and validations in one submittal package.

1.3.1 Insulation Products

Provide product certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification by other third-party programs. Provide current product certification from certification body.

1.3.2 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.

## 1.4 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 SOUND-ATTENUATION BLANKET INSULATION

Type I, blankets without membrane coverings produced by combining thermosetting resins with fiber manufactured from glass, slag wool, or rock wool.

Fire-Resistance Rated Asseblies: Comply with mineral-fiber requirements of assembly.

### 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 indoor air quality for insulation materials.

2.2 SILL SEALER INSULATION

Provide polyethylene foam sill sealer full width of base chaneel with the following characteristics:.

| Physical Properties | Test Method | Measurement |
|---|---|---|
| Nominal Thickness | ASTM D3575 | 3/16 inch |
| Compressive Strength | ASTM D3575 | 1.2 psi |
| - Vertical Direction | Suffix D | |
| Tensile Strength | ASTM D3575 | 32 psi |
| | Suffix T | |

2.3 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.

2.4 ACCESSORIES

2.4.1 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 indoor air quality for adhesives.

2.4.2 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

3.3 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 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

3.3.1.4 Cold Climate Requirement

Place insulation to the outside of pipes.

3.3.1.5 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.

3.3.1.6 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.

3.3.1.7 Installation of Sill Sealer

Size sill sealer insulation and place insulation over top of masonry or concrete perimeter walls or concrete perimeter floor slab on grade. Fasten sill plate over insulation.

3.3.1.8 Access Panels and Doors

Affix blanket insulation to access panels greater than one square foot and access doors in insulated floors and ceilings. Use insulation with same R-Value as that for floor or ceiling.

-- End of Section --

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SECTION 07 27 36

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SPRAY FOAM 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 |

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

| | |
|---|---|
| ASSP Z9.2 | (2018) Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems |
| ASSP Z88.2 | (2015) American National Standard Practices for Respiratory Protection |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C518 | (2021) Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus |
| ASTM C1029 | (2015) Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation |
| ASTM C1303/C1303M | (2015) Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation |
| ASTM C1338 | (2014) Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings |
| ASTM D1621 | (2016) Standard Test Method for Compressive Properties of Rigid Cellular Plastics |
| ASTM D1622 | (2014) Apparent Density of Rigid Cellular Plastics |
| ASTM D1623 | (2017) Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics |

| | |
|---|---|
| ASTM D4541 | (2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers |
| ASTM D6226 | (2015) Standard Test Method for Open Cell Content of Rigid Cellular Plastics |
| ASTM E84 | (2020) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E96/E96M | (2022) Standard Test Methods for Gravimetric Determination ofWater Vapor Transmission Rate of Materials |
| ASTM E119 | (2020) Standard Test Methods for Fire Tests of Building Construction and 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 E736 | (2000; R 2011) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members |
| ASTM E2178 | (2021a) Standard Test Method for Air Permeance of Building Materials |
| ASTM E2357 | (2017) Standard Test Method for Determining Air Leakage of Air Barrier Assemblies |

ICC EVALUATION SERVICE, INC. (ICC-ES)

| | |
|---|---|
| ICC-ES AC377 | (2016) Acceptance Criteria for Spray-Applied Foam Plastic Insulation |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IBC | (2018) International Building Code |

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

| | |
|---|---|
| ANSI/ISEA Z87.1 | (2020) Occupational and Educational Personal Eye and Face Protection Devices |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 10 | (2022; ERTA 1 2021) Standard for Portable Fire Extinguishers |
| NFPA 31 | (2020) Standard for the Installation of Oil-Burning Equipment |

| | |
|---|---|
| NFPA 54 | (2021) National Fuel Gas Code |
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |
| NFPA 211 | (2019) Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances |
| NFPA 275 | (2017) Standard Method of Fire Tests for the Evaluation of Thermal Barriers |
| NFPA 285 | (2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components |

SPRAY POLYURETHANE FOAM ALLIANCE (SPFA)

| | |
|---|---|
| SPFA TechDocs | (2015) SPFA Technical Documents Library, four categories: General, Insulation, Roofing, Specialty |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-600-01 | (2016; with Change 6, 2021) Fire Protection Engineering for Facilities |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.132 | Personal Protective Equipment |
| 29 CFR 1910.133 | Eye and Face Protection |
| 29 CFR 1910.134 | Respiratory Protection |

UNDERWRITERS LABORATORIES OF CANADA (ULC)

| | |
|---|---|
| ULC S705.2 | (2005) Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Application |

## 1.2 DEFINITIONS

### 1.2.1 Long Term Thermal Resistance (LTTR)

The thermal resistance value of a closed cell foam insulation product measured using accelerated aging ASTM C1303/C1303M equivalent to the time-weighted average thermal resistance value over 15 years. Loss in thermal resistance is attributable to changes in cell gas composition caused by diffusion of air into and blowing agent out of the foam cells.

### 1.2.2 SPFA TechDocs

Reformatted documents, named SPFA TechDocs ( http://www.sprayfoam.org/technical/spfa-technical-documents), places each document in one of four categories for easy reference and identification: Roofing, Insulation, Specialty and General.

Spray Polyurethane Foam: Thermal and air barrier system consisting of sprayed polyurethane foam (SPF).

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 Manufacturer; G-RO

Qualification of Installer; G-RO

Quality Control Plan; G-RO

Safety Plan; G-RO

Fire Prevention Plan; G-RO

Respirator Plan; G-RO

SD-02 Shop Drawings

Spray Foam Air Barrier System

Foam Air Barrier System; G-AE

SD-03 Product Data

Open Cell SPF; G-AE

Primers, Adhesives, and Mastics; G-AE

Sealants; G-AE

Safety Data Sheets; G-AE

Thermal Barrier Materials; G-AE

Recycled Content for Open Cell Spray Foam Air Barrier

SD-04 Samples

Spray Foam Air Barrier Mockup; G-RO

SD-06 Test Reports

Field Peel Adhesion Test; G-RO

Primers; G-RO

Fire-Ratings Of Thermal Barrier Materials; G-RO

Flame Spread And Smoke Developed Index Ratings Of SPF Products; G -RO

Flame Propagation Of Wall Assemblies; G-RO

Site Inspections Reports; G-RO

SD-07 Certificates

Open cell SPF; G-RO

Indoor Air Quality for Spray Foam Air Barrier

SD-08 Manufacturer's Instructions

SPF Handling, Storage, and Spray Procedures; G-RO

Substrate Preparation; G-RO

Thermal Barrier; G-RO

Primers, Adhesives, and Mastics; G-RO

SD-09 Manufacturer's Field Reports

Core Samples; G-RO

Daily Work Record; G-RO

## 1.4 MISCELLANEOUS REQUIREMENTS

For the spray foam air barrier system provide the following:

### 1.4.1 Shop Drawings

Submit spray foam air barrier shop drawings showing locations, detailing, and extent of spray foam air barrier assemblies. Provide details of all typical conditions, intersections with other envelope assemblies and materials, membrane counter-flashings. Provide details and indicate materials for thermal barriers. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the SPF without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

### 1.4.2 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. Submit thermal barrier literature including material description, physical properties, and fire-ratings.

### 1.4.3 Mockup

Provide a mockup of each foam system specified. Apply foam in an area designated by the Contracting Officer. Apply an area of not less than 50 square feet. Include all components specified for the finished assembly including primers, support components, expansion and contraction joints, thermal barriers, and other accessories as representative of the complete

system. Isolate the area and protect workers as required by 29 CFR 1910.132, 29 CFR 1910.133 and 29 CFR 1910.134. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be sprayed including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

### 1.4.4 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 spread and smoke developed index ratings of SPF products tested in accordance with ASTM E84. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports for fire-ratings of thermal barrier materials tested in accordance with ASTM E84.

## 1.5 DELIVERY, STORAGE, AND HANDLING

### 1.5.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage; unload 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. Submit SPF Handling, Storage, and Spray Procedures in accordance with submittal procedures.

### 1.5.2 Storage

Store materials in clean, dry areas, away from excessive heat, sparks, and open flame. Maintain temperatures in the storage area below the materials' flash point(s) and within limits recommended by the manufacturer's printed instructions. Provide ventilation in accordance with ASSP Z9.2 to prevent build-up of flammable gases. Store MDI (A-side) drums in locations that limit the risk of contact with water, acids, caustics (such as lye), alcohols, and strong oxidizing and reducing agents.

### 1.5.3 Handling

Handle materials and containers safely and in accordance with manufacturer's recommendations. Store liquids in airtight containers and keep containers closed except when removing materials. Do not use equipment or containers containing remains of dissimilar materials. Do not expose foam component containers to direct sunlight. Do not use materials from containers with content temperatures in excess of 80 degrees F.

Containers exposed to long periods of cold may also exhibit separation and poor performance. Do not use materials exposed to temperature ranges outside of manufacturer's instructions for exposure limits.

Mark and remove from job site materials which have been exposed to moisture, that exceed shelf life limits, or that have been exposed to temperature extremes.

#### 1.5.3.1 Venting and Handling of Material Containers

Partially unscrew material container and drum caps to gradually vent the containers prior to opening. Do not inhale vapors. Decontaminate empty component containers by filling with water and allowing to stand for 48 hours with bung caps removed. Do not, under any circumstances seal, stop, or close containers which have been emptied of foam components.

## 1.6 FIELD PEEL ADHESION TEST

Perform a field peel adhesion test on the construction mockup. Test the SPF 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.

## 1.7 SAFETY PROVISIONS

### 1.7.1 Fire Prevention

Provide a written fire prevention plan for the SPF application. Address specific fire hazards such as spontaneous combustion from exothermic heat build-up of SPF components during curing. Provide a continuous fire watch during mixing and spraying of SPF and for a minimum of two hours after completion of work at the end of each day. Maintain fire watch for additional time as required to ensure no potential ignition conditions exist.

#### 1.7.1.1 Fire Extinguishers

Furnish two fire extinguishers of minimum 15 pounds capacity each, in accordance with NFPA 10, in the immediate vicinity of the work. CAUTION: Do not discharge high pressure carbon dioxide extinguishers where explosive vapors exist since the discharge can cause a spark which will ignite the vapors.

### 1.7.2 Respirator Plan

Provide a written respirator plan in accordance with OSHA regulations that protects installers during application and addresses separation of the area to prevent other workers from entering the work area during spraying.

### 1.7.3 Isolation

Isolate the work area as recommended by spray foam manufacturer's written requirements. Prevent workers without respiratory, skin, and eye Personal Protective Equipment (PPE) or training from entering the work area or otherwise being exposed to off-gassing of the insulation in excess of permissible exposure limits.

1.7.4 Respirators and Eye Protection

Respiratory protective devices (respirators) must meet the requirements of ASSP Z88.2. Eye and face protective equipment must meet the requirements of ANSI/ISEA Z87.1. Additionally, sprayers and workers in the immediate vicinity of the spray must wear NIOSH-approved, full-face, supplied air respirators (SAR) operated in positive pressure or continuous flow mode. Workers not in the immediate vicinity of the sprayer must wear air purifying respirators (APR) with an organic gas / P100 particulate cartridge. Instruct personnel in the use of devices. Maintain such equipment and inspect regularly. All workers are required to have undergone pulmonary function testing and fit testing and must provide certification that they have done so. Change APR cartridges in accordance with manufacturer's written recommendations.

1.7.5 Clothing and Gloves

Sprayers and workers must wear protective clothing and gloves in accordance with OSHA requirements during materials application. Disposable coveralls must be worn and must cover all exposed skin. Sprayers and workers must wear fabric gloves coated with nitrile, neoprene, butyl or PVC.

1.7.6 Additional Requirements

Require personnel to review the Health, Safety and Environmental Aspects of Spray Polyurethane Foam and Coverings published by the Spray Polyurethane Foam Alliance (SPFA). Verify compliance prior to allowing personnel on site for installation work. http://www.sprayfoam.org.

1.8 QUALITY ASSURANCE

1.8.1 Qualification of Manufacturer

Submit documentation verifying that the manufacturer of the SPF is currently accredited by the Air Barrier Association of America ( ABAA Accreditation https://www.airbarrier.org/) and by the Spray Polyurethane Foam Alliance (SPFA).

1.8.2 Qualification of Installer

Submit documentation verifying that installers of the spray foam air barrier are currently certified by ABAA/BPQI (Building Performance Quality Institute) and by the Spray Polyurethane Foam Alliance (SPFA) Professional Certification Program (PCP). Installers must provide photo identification certification cards for inspection upon request.

1.8.3 General Quality Requirements

Provide all products and installation in accordance with SPFA TechDocs requirements (http://www.sprayfoam.org/technical/spfa-technical-documents) and documented best practices.

1.9 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting after approval of submittals and a minimum of two weeks prior to commencing work specified in this Section. Attendance is required by the Contracting Officer's designated personnel, Contractor, and representatives of related trades including covering

materials, substrate materials, adjacent materials, and materials and components of the air/thermal barrier system. Agenda must include, at a minimum, the following items:

a. Drawings, specifications and submittals related to the SPF work;

b. Sequence of construction;

c. Coordination with substrate preparation work and responsibility of repairing defects in substrates. Determine method of ensuring SPF work does not begin until substrates have been inspected and accepted;

d. Compatibility of materials;

e. Construction and testing of construction mockup;

f. Application of self-adhering air barrier transitions strips and primer as required for sealing the spray foam air barrier system at openings including but not limited to windows, doors and louvers;

g. Spray foam air barrier system installation; including methods to be used to provide a continuous barrier at thru-wall flashing, penetrations, and covering of embed items;

h. Quality control plan including methods of applying the product so that a consistent thickness across the face of the substrate is achieved.

i. Procedures for SPF manufacturer's technical representative's onsite inspection and acceptance of substrates, contact info for the representative, frequency of visits, and distribution of copies of inspection reports. Determine where core samples will be taken and review procedures for daily documentation of SPF application.

j. Property protection measures, including isolation of the work, and prevention of overspray and clean-up should overspray occur.

k. Safety requirements, including review of PPE, fire prevention, safety plan, respirator plan, ventilation and separation of the work area, fall protection, and posting of warning signs. Provide a complete schedule and a detailed, written fire protection plan including temporary isolation of the product and the work area until permanent isolation or thermal barrier is in place.

## 1.10 ENVIRONMENTAL CONDITIONS

### 1.10.1 Temperature and Weather

Install SPF within the range of ambient and substrate surface temperatures in accordance with manufacturer's written instructions. Do not apply SPF to damp or wet substrates. Do not apply SPF during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent. Do not apply SPF to exterior building surfaces when wind speeds exceed 25 miles per hour. Use moisture measuring methods and equipment to verify that the moisture conditions of substrate surfaces are in accordance with SPF manufacturer requirements prior to application. Substrate temperatures must be within limits recommended by the manufacturer's printed instructions.

1.10.2 Conditions for Primers

Follow manufacturer's printed application and curing instructions. Do not apply primer when ambient temperature is below 40 degrees F or when ambient temperature is expected to fall below 35 degrees F for the duration of the drying or curing period.

1.10.3 Conditions for Thermal Barriers

Ensure that sprayed surfaces comply with manufacturer's written requirements for application coverage, thickness, and curing prior to application of thermal barrier coatings.

1.10.4 Temporary Ventilation

Provide temporary ventilation for work of this section in accordance with manufacturer's written instructions and with OSHA requirements for this type of application.

1.11 FOAM SPRAY EQUIPMENT

1.11.1 Applicator

Use an air purge foam spray gun.

1.11.2 Equipment Calibration

Fully calibrate the foam metering equipment to monitor each liquid component to within 2 percent of the SPF manufacturer's required metering ratio. Calibrate spray equipment each day at the start of operations, after each restart if spraying operations have been terminated for more than one hour, whenever there is a change in fan pattern or pressure, whenever slow curing areas are noticed, whenever a change is made in hose length or working height, and after changeover between materials. Calibration consists of demonstrating that the equipment is adjusted to deliver components in proper mix and proportion. Conduct calibration tests on cardboard or plywood on a wall adjacent to the area to be sprayed.

1.11.3 Metering Equipment Requirements

Use foam metering equipment capable of developing and maintaining the SPF manufacturer's required liquid component pressures and temperatures. Foam metering equipment must have gages for visual monitoring. Equipment must provide temperature control of foam components to within the temperature ranges recommended by the foam manufacturer's printed instructions.

1.11.4 Moisture Protection

Protect surfaces of supply containers and tanks used to feed foam metering equipment from moisture.

1.11.5 Compressed Air

Supply compressed air that is in contact with SPF during mixing or atomization through moisture traps that are continuously bled.

1.11.6 Dispense Excess Materials

Do not deposit materials used for cleaning of equipment or materials

dispensed for calibration purposes and establishment of spray gun pattern onto the ground. Dispense such materials into scrap containers or onto plastic film, or cardboard, and dispose of in accordance with safety requirements and jobsite regulations.

PART 2 PRODUCTS

2.1 SPRAY FOAM AIR BARRIER

2.1.1 General

Provide an open cell, sprayed in place, SPF that forms a continuous air /thermal barrier at the building enclosure. Provide in accordance with ASTM C1029, with the requirements of UFC 3-600-01, ICC IBC Chapter 26, ICC-ES AC377, and NFPA 285. In the event of a conflict, the most stringent requirement applies. Provide all system components necessary for a complete, code compliant installation, whether indicated or not, including material support components, expansion and contraction joints, thermal barrier materials, and accessories.

2.1.2 Physical Properties

Provide an open cell product with the following characteristics:

a. Density (ASTM D1622): 0.5 lb per cf, nominal

b. Thermal Resistance (ASTM C518)

(1) Initial R-value per inch thickness: 4 sf·degrees F·h per Btu)

(2) Aged R-value per inch thickness (180 days at 76 degrees F): 3.8 sf·degrees F·h per Btu

c. Air Permeance (ASTM E2178): less than 0.004 CFM per sf at 1.57 psf.

d. Air Leakage (ASTM E2357, ASTM E283): Less than 0.04 CFM per sf at 1.57 psf at one inch.

e. AC377 Compressive Strength (ASTM D1621): 3-5 psi

f. Tensile Strength (ASTM D1623): 3-5 psi

g. Water Vapor Permeance (ASTM E96/E96M, water method): Maximum 22 Perms at 2 inch thickness

h. Surface Burning Characteristics (ASTM E84) 3 inch thickness:

(1) Flame Spread (FS) Index Rating less than 75.

(2) Smoke Developed (SD) Index Rating less than 150. SPF with an SD rating greater than 150 but less than 450 may be used when fully encapsulated. Approval of SPF product is contingent upon approval of encapsulation products and assemblies.

i. Open Cell Content (ASTM D6226): Greater than 92 percent

j. Fungi Resistance (ASTM C1338): Pass, with no growth

k. Recycled Content: minimum 9 percent (pre- and post-consumer).

Provide data identifying percentage of recycled content for open cell spray foam air barrier.

2.1.3 Expansion and Contraction

Provide an assembly that allows for relative movement due to temperature, moisture, and air pressure changes. Provide expansion and contraction measures as required by the manufacturer's written recommendations.

2.1.4 Fire-ratings, Flame Spread and Smoke Developed Index Ratings

Where fire-rated materials are indicated, provide products with the appropriate markings of a qualified testing agency. Submit fire-rating test reports. Submit flame spread (FS) and smoke developed (SD) index data. Where FS and SD values of foam products do not meet requirements, provide corresponding thermal barrier products or assemblies and verify complete encapsulation of the spray foam air barrier through product data or on shop drawings. Submit for approval in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

2.1.5 Prohibited Materials

Products that contain hexabromocyclododecane (HBCD) flame retardants are prohibited. Products that contain hydrochlorofluorocarbons (HCFCs), chlorofluorocarbons (CFCs), or other high ozone depleting blowing agents, are prohibited. For a list of acceptable substitute foam blowing agents see https://www.epa.gov/snap/foam-blowing-agents. Provide validation of indoor air quality for spray foam air barrier that no prohibited materials are used.

2.1.6 Thermal Barrier

Provide a thermal barrier in locations where SPF is exposed to the interior of the building, including attics and plenum spaces. Provide thermal barriers in accordance with ICC IBC Chapter 26 "Plastics," with ICC-ES AC377, ASTM E736, and NFPA 275. Choose one or more of the following methods of separation:

a. Building interior, other than fire-rated enclosures: Separate the SPF from the occupied interior of a building by an intumescent thermal barrier coating or thermal barrier board identical to a third party tested thermal barrier to limit the average temperature rise of the surface of the SPF to not more than 250 degrees F after 15 minutes of fire exposure (using the standard time-temperature curve of ASTM E119). Provide in accordance with NFPA 275.

2.2 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics and other accessory materials as recommended by spray foam manufacturer's printed literature.

2.3 JOINT SEALANTS

As specified in Section 07 92 00 JOINT SEALANTS. Verify compatibility with other system products.

## PART 3 EXECUTION

### 3.1 EXAMINATION

Before installing the spray foam air barrier and with the installer present, examine substrates, areas, and conditions under which SPF will be applied, for compliance with requirements. Ensure that surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants. Ensure that concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions. Correct defects that adversely affect the spray foam application or performance. Verify that work by other trades is in place and complete prior to application of spray foam.

### 3.2 PREPARATION

#### 3.2.1 Substrate Preparation

Clean, prepare, and treat substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for spray foam application.

a. Prepare surfaces by brushing, scrubbing, scraping, or grinding to remove loose mortar, dust, oil, grease, oxidation, mill scale and other contaminants which will affect adhesion of the SPF.

b. Wipe down metal surfaces to remove release agents or other non-compatible coatings, using clean sponges or rags soaked in a solvent compatible with the SPF.

#### 3.2.2 Protection

Protect adjacent areas and surfaces from spray applied materials in accordance with the following:

a. Mask and cover adjacent areas to protect from over spray.

b. Ensure required foam stops and back up materials are in place to achieve a complete seal.

c. Seal off ventilation equipment. Install temporary ducting and fans to provide required exhaust of spray fumes. Provide make-up air as required.

d. Erect barriers, isolate area, and post warning signs to notify non-protected personnel of the requirement to avoid the spray area.

#### 3.2.3 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed light fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: Minimum of 3 inches from outside face of fixtures and devices and in accordance with NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Masonry chimneys or masonry enclosing a flue: a minimum of 2 inches

from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances in accordance with NFPA 211.

c. Vents and vent connectors used for venting products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances in accordance with NFPA 211.

d. Gas Fired Appliances: Clearances in accordance with NFPA 54.

e. Oil Fired Appliances: Clearances in accordance with NFPA 31. Blocking is not required if chimneys or flues are certified by the manufacturer for use in contact with insulating materials.

3.2.4 Fire and Explosion Hazards

Prohibit open flames, sparks, welding, and smoking in the application area. Provide and maintain fire extinguishers of appropriate type, size and distance, as required by NFPA, in the application area. Mix batches in small enough quantities to avoid spontaneous combustion from exothermic heat build-up of SPF components during curing.

3.2.5 Warning Signs

Post warning signs at ground level adjacent to the work area and a minimum of 150 feet from the application area stating the area is off limits to unauthorized persons and warning of potential hazards. Place clearly visible and legible warning sign at entrance to primary road leading to the project facility warning of presence of flammable materials, irritating fumes, and potential of overspray damage.

3.2.6 Prime Substrate

Provide as recommended by the manufacturer for each substrate to be primed. Use primers at full strength. Do not dilute primers unless required and as recommended in writing by the manufacturer. Do not use cleaning solvents for thinning primers or other materials. Ensure that diluted primer(s) meet VOC requirements.

3.3 INSTALLATION

3.3.1 Sequencing and Coordination

Sequence the work so as to prevent access to the work area by other trades during foam application and curing. Limit access of non-essential workers during application. Notify the Contracting Officer 24 hours in advance of spraying operations. Ensure expansion and control joints are provided as detailed on the manufacturer's shop drawings to accommodate the expansion of each layer of the air/thermal envelope. Provide temporary fire protection of uncured foam, and isolate the work area, until foam application is isolated with a permanent thermal barrier.

3.3.2 Installation of Spray Foam Air Barrier

Install materials in accordance with paragraph SAFETY PROVISIONS, in accordance with manufacturer's recommendations, ULC S705.2 Installation Standard, and in accordance with the following:

a. Use spray equipment that complies with foam manufacturer's

recommendations for the specific type of application, and as specified herein. Record equipment settings on the Daily Work Record. Each proportioned unit can supply only one spray gun.

b. Apply only when surfaces and environmental conditions are within limits prescribed by the material manufacturer.

c. Continuously connect the spray foam 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 spray foam air barrier into rough openings such as doors, windows, louvers, and other exterior penetrations. Use self-adhering air barrier transition strips if necessary to achieve full extension and continuity of the barrier at these locations. Seal edges of barrier at junctures with rough openings.

d. Install within manufacturer's tolerances, but not more than minus 1/4 inch or plus 1/2 inch.

e. Sequence work so as to completely seal all penetrations resulting from pipes, vents, wires, conduit, electrical fixtures, structural members, or other construction. If penetrations through the spray foam air barrier are made after the initial SPF application, reapply in accordance with manufacturer's written instructions for such remedial work.

f. Do not install SPF within 3 inches of heat emitting devices such as light fixtures and chimneys.

g. Finished surface of SPF must be free of voids and embedded foreign objects.

h. Remove masking materials and over spray from adjacent areas immediately after foam surface has hardened. Ensure cleaning methods do not damage work performed by other sections.

i. Trim, as required, any excess thickness that would interfere with the application of cladding and covering system by other trades.

j. Clean and restore surfaces soiled or damaged by work of other trades. Before cleaning and restoring damaged work, consult with other trades for appropriate and approved methods for cleaning and restoration to prevent further damage.

k. Complete connections to other components and repair any gaps, holes or other damage using material approved by the manufacturer.

l. Provide expansion joints in the SPF application aligned with expansion joints in the building enclosure, where substrate materials change, and in accordance with manufacturer's recommendations.

m. Provide a continuous fire watch in accordance with paragraph SAFETY PROVISIONS.

## 3.4 FIELD QUALITY CONTROL

### 3.4.1 General 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/).

a. Conduct inspections and testing at 5, 50, and 95 percent of completion of this scope of work. Forward written inspection reports to the Contracting Officer within 5 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.

3.4.2 Manufacturer Site Inspections

Manufacturer's technical representative must visit the site during the installation process to ensure the SPF and accessories are being applied in compliance with requirements. At a minimum, manufacturer's technical representative must be present at work startup and perform field inspection of the first day's completed application and at substantial completion, prior to demobilization. After each inspection, submit an inspection report signed by the manufacturer's technical representative, to the Contracting Officer within five working days. The inspection report must note overall quality of work, deficiencies, and recommended corrective actions in detail. Notify the Contracting Officer a minimum of two working days prior to site visits by manufacturer's technical representative.

3.4.3 Contractor's Site Inspections

Establish and maintain an inspection procedure to ensure compliance of the foam installation with contract requirements. Conduct inspections and testing at 5, 50, and 95 percent completion of application. Forward written inspection reports to the Contracting Officer within five working days of the inspection and test being performed. Work not in compliance must be promptly removed and replaced or corrected, in an approved manner, at no additional cost to the Government. Quality control must include, but is not limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers.

b. Verification of certification, listing, or label.

c. Verification of proper storage and handling of materials before, during, and after installation.

d. Inspection of SPF, support structure, primer, expansion joints, thermal barrier, and accessories.

3.4.4 Field Peel Adhesion Test

Conduct in accordance with test protocol indicated in Part 1 paragraph FIELD PEEL ADHENSION TEST.

3.5 CORRECTION OF DEFICIENCIES

Upon completion of inspection, testing, or sample taking, repair damaged construction, restore substrates and finishes, and protect repaired construction. Deficiencies found during inspection must be corrected within 5 working days following notification.

## 3.6 CLEANUP OF SPILLS

Conduct cleanup of uncured product spillage in accordance with paragraph SAFETY PROVISIONS and the manufacturer's written safe handling instructions. In the event of a conflict, the most stringent requirement governs.

## 3.7 PROTECTION AND CLEANING

### 3.7.1 Protection of Installed Work

Protect SPF installation from damage during application and remainder of construction period in accordance with manufacturer's written instructions. Repair damaged areas to new condition.

### 3.7.2 Cleaning of Adjacent Surfaces

Clean overspray 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.

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METAL WALL PANELS
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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.

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 |

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 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 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 A924/A924M | (2022) 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 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 | (2020) 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; R 2021) Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials |

| | |
|---|---|
| ASTM G153 | (2013; R 2021) Standard Practice for 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 |

U.S. GREEN BUILDING COUNCIL (USGBC)

| | |
|---|---|
| LEED NC | (2013) Leadership in Energy and Environmental Design(tm) New Construction Rating System |

## 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 corrugated as shown on drawings and matching the adjacent existing wall panel.

### 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 A755/A755M for metallic coated steel sheet for exterior coil pre-painted applications.ASTM A924/A924M for metallic coated steel sheet

### 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; G-RO
Qualification of Installation Contractor; G-RO

Sample Warranty; G-RO

SD-02 Shop Drawings

Installation Drawings ; G-AE

SD-03 Product Data

Recycled Content; (LEED NC)

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-AE

Factory Color Finish
Closure Materials
Pressure Sensitive Tape
Sealants and Caulking
Galvanizing Repair Paint
Enamel Repair Paint
Accessories

SD-04 Samples

Submit as required each of the following samples:

Wall Panels, 12 inches long by actual panel width; G-RO
Fasteners; G-RO
Metal Closure Strips, 10 inches long of each type; G-RO

Color chart and chips ; G-RO

Submit manufacturer's color charts and chips, approximately 4 by 4 inches, showing full range of colors, textures and patterns available for wall panels with factory applied finishes.

SD-05 Design Data

Wind load design analysis ; G-AE

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-RO
Wind Load Tests; G-RO
Coating Tests; G-RO
Chalking Tests; G-RO

SD-07 Certificates

Submit certificates for the following items showing conformance with referenced standards contained in this section:

Coil Stock; G-RO
Fasteners; G-RO

Enamel Repair Paint; G-RO

SD-08 Manufacturer's Instructions

Include detailed application instructions and standard manufacturer drawings altered as required by these specifications.

Installation of Wall panels; G-RO

SD-09 Manufacturer's Field Reports

Submit 5 bound copies of the Manufacturer's Field Reports; G-RO

SD-11 Closeout Submittals

Warranty; G-RO
Maintenance Instructions; G-RO

20 year "No Dollar Limit" warranty for labor and material

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 chart 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
Enamel 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 WARRANTY

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.

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 Steel Sheet

Roll-form steel wall panels to the specified profile, with fy= 30 ksi, 20 gauge and depth as indicated. Material must be plumb and true, and within the tolerances listed:

c. Individual panels must be continuous length to cover the entire length of any unbroken 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.

d. 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. Profile to match existing adjacent panel profile.

### 2.2.2 Factory 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 exterior finish color as to match existing adjacent metal wall panels.

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 Hidden Fasteners

Provide corrosion resistant fasteners recommended by the manufacturer to meet the performance requirements and design loads.

2.4.1.2 Screws

Screws to be corrosion resistant coated steel, aluminum and/or 305 - series stainless steel being the type and size recommended by the manufacturer to meet the performance requirements.

2.4.1.3 Rivets

Rivets to be closed-end type, corrosion resistant coated steel, aluminum or stainless steel where watertight connections are required.

2.4.1.4 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 steel closure strips to be the same gauge, 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 enameled wall panel must be compatible paint of the same formula and color as the specified finish furnished by the wall panel manufacturer.

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 Steel Wall Panels

Use stainless-steel fasteners for exterior surfaces and 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 five bound copies of 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 or weld 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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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 84 00

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**05/10, CHG 1: 08/13**

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SECTION 07 84 00

FIRESTOPPING
**05/10, CHG 1: 08/13**

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; do not allow firestopping material to 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 E699 | (2009) Standard Practice for Evaluation of Agencies Involved in Testing, Quality Assurance, and Evaluating of Building Components |
| 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 | (2020a) Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers |

FM GLOBAL (FM)

| | |
|---|---|
| FM 4991 | (2013) Approval of Firestop Contractors |
| FM APP GUIDE | (updated on-line) Approval Guide http://www.approvalguide.com/ |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IBC | (2018) International Building Code |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 723 | (2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials |
| UL 1479 | (2015; Reprint May 2021) 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. Locate cast-in-place firestop devices and install in place before concrete placement. Install pipe, conduit or cable bundles through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material must 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" 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

Firestopping System; G-AE

SD-03 Product Data

Firestopping Materials; G-AE

SD-06 Test Reports

Inspection; G-RO

SD-07 Certificates

Inspector Qualifications

Firestopping Materials

Installer Qualifications; G-RO

## 1.5 QUALITY ASSURANCE

### 1.5.1 Installer

Engage an experienced Installer who is:

a. FM Research approved in accordance with FM 4991, operating as a UL Certified Firestop Contractor, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years 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. The Installer must be a trained representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. Obtain and submit installer's written certification of training, and retain proof of certification for duration of firestop installation.

### 1.5.2 Inspector Qualifications

The inspector must meet the criteria contained in ASTM E699 for agencies involved in quality assurance and must have a minimum of two years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector must be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector must 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, submit a manufacturer's engineering judgment, derived from similar UL system designs or other tests 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: VOC content of firestop materials installed on project is limited to < 250 g/l as calculated by EPA method 24.

#### 2.2.1 Fire Hazard Classification

Provide material that has 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. Provide an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

#### 2.2.2 Toxicity

Provide material that is nontoxic and carcinogen free to humans at all stages of application or during fire conditions and does not contain hazardous chemicals or require harmful chemicals to clean material or equipment.

#### 2.2.3 Fire Resistance Rating

Firestop systems must 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 must 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, must provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479. Provide fire resistance ratings as follows:

2.2.3.1.1 Penetrations of Fire Resistance Rated Walls and Partitions

F Rating = 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

F Rating = 1 hour, T Rating = 1 hour. 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 must 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

F Rating = 1 hour, T Rating = 1 hour and L Rating = <10 cfm/sf.

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 must be the same as the construction in which they occur. Provide construction joints and gaps 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. Provide curtain wall joints 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 must meet the cycling requirements of ASTM E1399/E1399M or UL 2079. Provide a minimum class II movement capability for 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.

2.2.4 Material Certification

Submit certificates attesting that firestopping material complies with the specified requirements. Provide certification of compliance with UL 1479 for all intumescent firestop materials used in through penetration systems.

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

Cut and remove thermal insulation 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

Seal cabling for data and communication applications with re-enterable firestopping products and devices as indicated.

#### 3.2.3.1 Re-Enterable Devices

Provide firestopping devices that are pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. 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. Allow for cable moves, additions or changes. Provide devices 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 all projects, do not cover or enclose the firestopped areas until inspection is complete and approved by the Contracting Officer. 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; record type 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 --

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SECTION 07 92 00

JOINT SEALANTS
**08/16, CHG 3: 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.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C734 | (2015; R 2019) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering |
| ASTM C919 | (2022) 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 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 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 |

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-03 Product Data

Sealants; G-AE

Primers; G-AE

Bond Breakers; G-AE

Backstops; G-AE

SD-06 Test Reports

Field Adhesion; G-RO

SD-07 Certificates

Indoor Air Quality For Interior Sealants;

Indoor Air Quality For Interior Floor Joint Sealants;

Indoor Air Quality For Interior Acoustical Sealants;

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 CERTIFICATIONS

1.4.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.4.1.1 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 program 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 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

## 1.6 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.

## 1.7 QUALITY ASSURANCE

### 1.7.1 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.

### 1.7.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

### 1.7.3 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.

### 1.7.4 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.

In areas with ambient temperatures that exceed 110 degrees F, do not use polybutene, bituminous, acrylic-latex, polyvinyl acetate latex sealants, polychloroprene (neoprene), polyvinyl chloride (PVC), and polyurethane foams, and neoprene, PVC, and styrene butadiene rubber extruded seals and closure strips due to these materials having maximum recommended surface temperature ranges from 130 to 180 degrees F.

### 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. | As selected |
| c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed. | As selected |
| d. Joints between edge members for acoustical tile and adjoining vertical surfaces. | As selected |
| e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted. | As selected |
| f. Joints between shower receptors and ceramic tile; joints formed where non-planar tile surfaces meet. | As selected |
| g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change. | As selected |
| h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers. | As selected |
| | |

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. | Match adjacent surface color |

| LOCATION | COLOR |
|---|---|
| b. Joints between new and existing exterior masonry walls. | Match adjacent surface color |
| c. Masonry joints where shelf angles occur. | Match adjacent surface color |
| d. Joints in wash surfaces of stonework. | Match adjacent surface color |
| e. Expansion and control joints. | Match adjacent surface color |
| f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required. | Match adjacent surface color |
| g. Voids where items pass through exterior walls. | Match adjacent surface color |
| h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels. | Match adjacent surface color |
| i. Metal-to-metal joints where sealant is indicated or specified. | Match adjacent surface color |
| j. Joints between ends of gravel stops, fascia, copings, and adjacent walls. | Match adjacent surface color |
| | |

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 |

| LOCATION | COLOR |
|---|---|
| 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.

2.2 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.

2.5 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:

| JOINT WIDTH | JOINT DEPTH | |
|---|---|---|
| | 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, or stone: | | |
| 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 |
| 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 --

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STEEL DOORS AND FRAMES

**08/20**

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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 | (2022) 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 | (2021) 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) |

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 | (2022) Standard for Fire Doors and Other Opening Protectives |
| NFPA 105 | (2022) Standard for Smoke Door Assemblies and Other Opening Protectives |
| NFPA 252 | (2022) Standard Methods of Fire Tests of Door Assemblies |

STEEL DOOR INSTITUTE (SDI/DOOR)

| | |
|---|---|
| SDI/DOOR 111 | (2009) Recommended Details for Standard Steel Doors, Frames, and Accessories and Related Components |
| 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; Reprint May 2021) UL Standard for Safety Positive Pressure Fire Tests of Door Assemblies |

## 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-AE

Frames; G-AE

Accessories

Schedule of Doors; G-AE

Schedule of Frames; G-AE

SD-03 Product Data

Doors; G-AE

Recycled Content for Steel Door Product

Frames; G-AE

Recycled Content for Steel Frame Product

Accessories

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.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B, Model 1, with core construction as required by the manufacturer for interior 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.

2.1.1.2 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 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 exterior doors 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 other specific doors noted in the door schedule, and provide an apparent U-factor of .48 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 3, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners. Provide steel frames for doors, transoms, sidelights, mullions, and interior glazed panels, 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 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated not lighter than 18 gage.

2.5.4.1 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;

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and

2.5.4.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

2.6 FIRE AND SMOKE DOORS AND FRAMES

Provide fire and smoke doors and frames in accordance with NFPA 80 and NFPA 105 and this specification. Include insulated core materials in fire doors where indicated in the door schedule.

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.

2.6.2 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

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 oror soundproof 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, or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

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. Provide for exterior doors.

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.

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.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire and Smoke Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

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.

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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.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

| | |
|---|---|
| AAMA 2604 | (2017a) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE 90.1 - IP | (2019; Errata 1 2019; Errata 2-6 2020; Addenda BY-CP 2020; Addenda AF-DB 2020; Addenda A-G 2020; Addenda F-Y 2021; Errata 7-8 2021; Interpretation 1-6 2021; Addenda AS-BF 2022) 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 |

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

| | |
|---|---|
| NFRC 100 | (2020) Procedure for Determining Fenestration Product U-Factors |
| NFRC 200 | (2020) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence |

1.2 PERFORMANCE REQUIREMENTS

1.2.1 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.

1.2.2 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.

1.2.3 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/

1.2.3.1 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 U-0.77 maximum as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 100.

1.2.3.2 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 SHGC-0.40 maximum as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 200.

1.2.3.3 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 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-AE

SD-03 Product Data

For Each Type of Door and Frame Assembly; G-AE

Recycled Content of Aluminum Material

SD-04 Samples

Finish Samples; G-AE

SD-06 Test Reports

Air Infiltration; G-RO

Water Penetration; G-RO

SD-07 Certificates

NFRC Project Label Certificates for Fenestration; G-RO

SD-08 Manufacturer's Instructions

Installation of Each Type of Door and Frame Assembly; G-RO

SD-10 Operation and Maintenance Data

Adjustments, Cleaning, and Maintenance; G-RO

SD-11 Closeout Submittals

NFRC Project Label Certificates for Fenestration; G-RO

## 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, subframe attachment, thickness and gages of metal, details of door and frame construction, proposed method(s) of anchorage, glazing details, provisions for an location of hardware, mullion details, 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, trim, and accessories. Coordinate side lites, window walls, adjacent curtainwall with Section 08 41 13 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS.

## 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.

## 2.3 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.

#### 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.

### 2.3.3 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

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill. 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.

2.3.7 Provisions for Glazing

Coordinate requirements with Section 08 81 00 GLAZING.

2.3.8 Finishes

Provide exposed aluminum surfaces with factory finish of organic coating.

2.3.8.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a high-performance finish in accordance with AAMA 2604 with total dry film thickness of minimum 1.2 mils. Finish color to be as indicated on the drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors, transoms, adjoining side lites, and, adjoining window walls. 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. 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.

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WOOD DOORS

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WOOD DOORS
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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 in the text by the basic designation only.

AMERICAN FOREST FOUNDATION (AFF)

| | |
|---|---|
| ATFS STANDARDS | (2015) American Tree Farm System Standards of Sustainability 2015-2020 |

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 |

CALIFORNIA AIR RESOURCES BOARD (CARB)

| | |
|---|---|
| CARB 93120 | (2007) Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products |

CSA GROUP (CSA)

| | |
|---|---|
| CSA Z809-08 | (R2013) Sustainable Forest Management |

FOREST STEWARDSHIP COUNCIL (FSC)

| | |
|---|---|
| FSC STD 01 001 | (2015) Principles and Criteria for Forest Stewardship |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 80 | (2022) Standard for Fire Doors and Other Opening Protectives |
| NFPA 105 | (2022) Standard for Smoke Door Assemblies and Other Opening Protectives |
| NFPA 252 | (2022) Standard Methods of Fire Tests of Door Assemblies |

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)

| | |
|---|---|
| PEFC ST 2002:2013 | (2015) PEFC International Standard Chain |

| | |
|---|---|
| | of Custody of Forest Based Products Requirements |

SUSTAINABLE FOREST INITIATIVE (SFI)

| | |
|---|---|
| SFI 2015-2019 | (2015) Standards, Rules for Label Use, Procedures and Guidance |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 40 CFR 770 | Formaldehyde Standards for Composite Wood Products |

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 |

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

Doors; G-AE

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-AE

Recycled Content for Door Cores

Accessories

Sample Warranty

Sound Transmission Class Rating; G-AE_

Fire Resistance Rating; G-AE

SD-04 Samples

Doors

Prior to the delivery of wood doors, submit a sample section of each type of door which shows the stile, rail, veneer, finish, and core construction.

Door Finish Colors; G-AE

Submit a minimum of three color selection samples , minimum 3 by 5 inches in size representing wood stain for selection by the 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

Certified Sustainably Harvested Flush Wood Doors

Indoor Air Quality for Particleboard and Agrifiber Door Cores

SD-11 Closeout Submittals

Warranty

## 1.3 CERTIFICATIONS

### 1.3.1 Certified Wood Grades

Provide certificates of grade from the grading agency on acoustical doors and fire doors.

### 1.3.2 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08, SFI 2015-2019, or other third party program certified by PEFC ST 2002:2013. Provide a letter of Certification of Sustainably Harvested Wood signed by the wood supplier. Identify certifying organization and their third party program name and indicate compliance with chain-of-custody program requirements. Submit sustainable wood certification data; identify each certified product on a line item basis. Submit copies of invoices bearing certification numbers.

1.3.3 Indoor Air Quality Certification

1.3.3.1 Composite Wood, Wood Structural Panel and Agrifiber Products

For purposes of this specification, composite wood and agrifiber products include particleboard, medium density fiberboard (MDF), wheatboard, strawboard, panel substrates, and door cores. Provide products certified to meet requirements of both 40 CFR 770 and CARB 93120. Provide current product certification documentation from certification body.

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 core, Type II flush doors conforming to ANSI/WDMA I.S.1A with faces of premium grade natural birch. Hardwood veneers must be rotary cut. 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 as noted on the drawings 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 including exterior doors 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 factory finished and factory 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 and louvers. 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 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows: WDMA System TR-8 (UV cured acrylated polyester/urethane) or TR-2 (catalyzed lacquer) or TR-4 (conversion varnish) factory finish systems that utilize water-based stains and finishes with ultraviolet UV protection. The coating is NAAWS 3.1 premium, medium rubbed sheen, open grain effect. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

2.3.6.2 Color

Provide door finish colors in accordance with the Finish Legend on the drawings.

2.4 SOURCE QUALITY CONTROL

Meet or exceed the following minimum performance criteria of stiles of "B" and "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 and Smoke Doors

Install fire doors in accordance with NFPA 80. Install smoke doors in accordance with NFPA 105. Do not paint over labels.

-- End of Section --

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DIVISION 08 - OPENINGS

SECTION 08 31 00

ACCESS DOORS AND PANELS

**05/17, CHG 1: 08/18**

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-- End of Section Table of Contents --

SECTION 08 31 00

ACCESS DOORS AND PANELS
**05/17, 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 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 |
| ASTM E90 | (2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements |
| ASTM E119 | (2020) Standard Test Methods for Fire Tests of Building Construction and Materials |
| ASTM E413 | (2022) Classification for Rating Sound Insulation |
| ASTM E1332 | (2016) Standard Classification for Rating Outdoor-Indoor Sound Attenuation |

MASTER PAINTERS INSTITUTE (MPI)

| | |
|---|---|
| MPI 79 | (2016) Primer, Alkyd, Anti-Corrosive for Metal |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 252 | (2022) Standard Methods of Fire Tests of Door Assemblies |
| NFPA 288 | (2017) Standard Methods of Fire Tests of Horizontal Fire Door Assemblies Installed in Horizontal Fire Resistance-Rated Assemblies |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 10B | (2008; Reprint May 2020) Fire Tests of Door Assemblies |
| UL 263 | (2011; Reprint Aug 2021) UL Standard for Safety Fire Tests of Building Construction and 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-02 Shop Drawings

Access Doors And Panels; G-AE

SD-03 Product Data

Access Doors And Panels; G-AE

Hardware Including Locks and Keys; G-AE

Accessories; G-AE

Recycled Content

SD-04 Samples

Finishes; G-AE

SD-06 Test Reports

Fire-rating(s) of Assemblies; G-RO

Acoustical Ratings of Assemblies; G-RO

## 1.3 MISCELLANEOUS REQUIREMENTS

For access doors and panels provide the following:

### 1.3.1 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. Indicate acoustical ratings of assemblies as sound transmission class (STC) ratings, and fire-rating(s) of assemblies.

1.3.2 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. Indicate acoustical ratings of assemblies and fire-ratings of assemblies. Provide details of adjoining work for each condition indicated.

1.3.3 Finish Samples

Submit two color charts from manufacturer's standard color and finish options for each type of frame and panel assembly finish indicated.

1.3.4 Test Reports

Provide test reports for acoustical assemblies when tested in accordance with ASTM E90 and classified in accordance with ASTM E413 and ASTM E1332. Provide test reports for fire-rated assemblies when tested in accordance with NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically and NFPA 288 for fire-rated access door assemblies installed horizontally.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Structural Requirements

Provide floor access assemblies to support live loads indicated for floors. Deflection must not exceed 1/180 of span.

1.4.2 Acoustical Requirements

Provide access panels with a minimum sound transmission class (STC) of as indicated on the Drawings. Provide gasketing in accordance with manufacturer's written recommendations.

1.4.3 Fire-Rating Requirements

Provide access panels with a minimum fire-rating as indicated on the Drawings.

1.4.4 Access Panels for Wet Areas

Provide panel assemblies that will be located in wet areas with corrosion resistant finishes and hardware and water resistant gasketing.

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. Provide anchors in accordance with applicable fire test parameters.

#### 2.2.6 Hinges

Provide concealed spring hinges, 175 degrees of opening, with non-removable hinge pins. 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 keyed lock.

#### 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 Fire-rated Doors

#### 2.4.1.1 Door Construction

Provide ceiling access door construction in accordance with ASTM E119 or UL 263. Provide wall access doors in accordance with NFPA 252 or UL 10B.

#### 2.4.1.2 Labels

Provide class B opening according to UL 10B or test by another nationally recognized laboratory, approved by the Contracting Officer. Provide fire-rating as indicated herein, with a maximum temperature rise of 216 degrees F.

#### 2.4.1.3 Door Panel and Frame

Steel sheet, with mineral fiber insulation core, insulated sandwich type construction.

### 2.4.2 Acoustical Doors

Manufacturer's standard assembly rated in accordance with STC requirements indicated herein. Acoustical insulating materials must have a flame spread rating of no more than 25.

## 2.5 FINISHES

Provide manufacturer's standard two coat finish system consisting of one coat primer and one thermoset topcoat. Provide dry film thickness in 2 mils minimum. 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 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action.

## 3.6 ADJUSTMENT

Adjust hardware so that door panel opens freely. Adjust door when closed center door panel in frame.

## 3.7 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.

-- End of Section --

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SECTION 08 33 23

OVERHEAD COILING DOORS

**08/20, CHG 1: 02/22**

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SECTION 08 33 23

OVERHEAD COILING DOORS
**08/20, CHG 1: 02/22**

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 HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| ASHRAE FUN IP | (2021) 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 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 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 | (2022) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| 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; R 2021) Standard Test Method for 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 |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA ICS 1 | (2000; R 2015) Standard for Industrial Control and Systems: General Requirements |
| NEMA ICS 2 | (2000; R 2020) 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 | (2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31 |
| NEMA ST 1 | (1988; R 1994; R 1997) Specialty Transformers (Except General Purpose Type) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |
| NFPA 80 | (2022) Standard for Fire Doors and Other Opening Protectives |

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-AE

Counterbalancing Mechanism; G-AE

Manual Door Operators; G-AE

Electric Door Operators; G-AE

Bottom Bars; G-AE

Guides; G-AE

Mounting Brackets; G-AE

Hood; G-AE

Installation Drawings; G-AE

SD-03 Product Data

Overhead Coiling Doors; G-AE

Hardware; G-AE

Counterbalancing Mechanism; G-AE

Manual Door Operators; G-AE

Electric Door Operators; G-AE

Fire-Rated Door Assembly; G-AE

Recycled content for steel curtain slats

SD-05 Design Data

Overhead Coiling Doors; G-AE

Hardware; G-AE

Counterbalancing Mechanism; G-AE

Manual Door Operators; G-AE

Electric Door Operators; G-AE

Fire-Rated Door; G-AE

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, Data Package 2; G-RO

SD-11 Closeout Submittals

Warranty; G-RO

1.3 QUALITY CONTROL

Provide fire-rated door assemblies bearing the Underwriters Laboratories, Warnock Hersey, Factory Mutual or other nationally recognized testing laboratory label for the hourly rating noted on the door schedule. Provide a permanent label for each door showing the manufacturer's name and address, and the model/serial number of the door.

Provide oversized fire-rated door assemblies with a listing agency oversize label, or a certificate signed by an official of the manufacturing company certifying that the door and operator are designed to meet the specified requirements.

1.3.1 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.

1.3.2 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:

Manual Door Operators

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.

1.4 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 or interior openings, as indicated. Doors must be operated by hand chain with gear or sprocket reduction or 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 as indicated.

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 on the drawings and in accordace 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 Fire-Rated Doors, Frames, and Hardware

Provide fire-rated doors, frames, and hardware that are tested, rated, and

labeled in accordance with Underwriters Laboratories, Factory Mutual or Warnock Hersey. Fire doors must be complete with hardware, accessories, and automatic closing device as required by NFPA 80. Indicate on the labels the rating in hours, per NFPA 80, of fire exposure duration. Additionally, ensure a letter follows the hourly rating to designate the location for which the assembly is designed and the temperature rise on the unexposed door face at the end of 30 minutes of fire exposure is required. The construction details necessary for labeled doors take precedence over details indicated or specified for non-labeled doors.

Provide and attach metal UL labels to the bottom bar.

2.1.2.3 Oversized Coiling Fire-rated Door Assemblies

Where fire-rated doors and frames exceed the size for which testing and labeling services are offered, furnish certificates of inspection from either UL, Factory Mutual or Warnock Hersey. State within certificates that except for size; doors, frames, and hardware are identical in design, materials, and construction to a door that has been tested and rated.

2.1.2.4 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 10 cycles per day. 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 Grade A steel sheets conforming to ASTM A653/A653M, with the additional requirement of a minimum yield point of 33,000 psi. Provide 18 gauge sheets, Grade 40 steel with galvanized steel zinc coating in conformance with ASTM A653/A653M and ASTM A924/A924M. Provide steel curtain slats containing a minimum of 20 percent recycled content. Submit data identifying percentage of recycled content for steel curtain slats.

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 Non-Insulated Curtains

Form curtains from the manufacturer's standard shapes of interlocking slats.

2.2.1.3 Insulated Curtains

Form curtains from manufacturer's standard shapes of interlocking slats. Supply a slat system with a minimum R-value of 4 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.

2.2.1.4 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.

2.2.1.5 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.

2.2.1.6 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.

2.2.1.7 Locking Devices

Provide a locking device assembly which includes cylinder lock, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

2.2.1.8 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 24-gauge 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.

2.2.4 Manual Door Operators

2.2.4.1 Manual Chain-Hoist Door Operators

Provide door operators which consist of an endless steel hand chain, chain-pocket wheel, guard, and a geared reduction unit of at least a 3 to 1 ratio with a maximum lifting force of 30 lbf. Required pull for operation cannot exceed 35 pounds. Chain must extend to within 3 feet of floor.

Provide chain hoists with a mechanism allowing the curtain to be stopped at any point in its upward or downward travel and to remain in that position until moved to the fully open or closed position. Provide hand chains of galvanized steel. Ensure that the yield point of the chain is at least three times the required hand-chain pull.

Provide chain sprocket wheels of cast iron conforming to ASTM A48/A48M.

2.2.5 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.

2.2.5.1 Door-Operator Types

Provide an operator mounted to the right or left door head plate with the operator on coil side of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Front clearance is required for this type of mounting.

2.2.5.2 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. Motor enclosures must be the drip-proof type or NEMA TEFC and TENV type. Install motors in approved locations.

2.2.5.3 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.

2.2.5.4 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; 24-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.

2.2.5.5 Control Enclosures

Provide control enclosures that conform to NEMA ICS 6 for oil-tight and dust-tight NEMA Type 12.

2.2.5.6 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 24volts or less. Provide a transformer conforming to NEMA ST 1.

2.2.5.7 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.

2.2.5.8 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.

2.2.5.9 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.

2.2.5.10 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.

2.2.5.11 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.

2.2.5.12 Clutches

Ensure clutches are friction type or adjustable centrifugal type.

2.2.5.13 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.

2.2.6 Fire-Rated Door Assembly

Provide fire-rated door assemblies with the dimensions, fire rating, and operating type indicated with electric operators and assemblies that do not interfere with manufacturer's standard interconnecting fusible links. Equip fire doors with an automatic closing mechanism. Doors must be forced into a closed position at a rate of descent of not more than 2 feet per second and not less than 6 inches per second without impact. The curtain must be held against the sill until the release mechanism has been reset. The automatic closing mechanism must not interfere with normal operation of the door.

Provide the door manufacturer's standard interconnecting fusible links for door assemblies on both sides of the wall opening.

2.2.6.1 Fire Ratings

Provide fire-rated door assemblies complying with NFPA 80 Standard for Fire Doors and Other Opening Protectives. Fire doors must be complete with hardware, accessories, and automatic closing device as required by NFPA 80.

2.2.7 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.

2.2.7.1 Baked-Enamel or Powder-Coat Finish

Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with the coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

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.

3.2 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 or alarm-connected fire-release 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**

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SOUND CONTROL DOOR ASSEMBLIES
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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.

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 D1056 | (2020) 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 | (2022) Classification for Rating Sound Insulation |
| ASTM E1289 | (2008; R 2022) Standard Specification for Reference Specimen for Sound Transmission Loss |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 80 | (2022) Standard for Fire Doors and Other Opening Protectives |
| NFPA 101 | (2021) Life Safety Code |
| NFPA 252 | (2022) 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-AE

Wood Sound Retardant Doors; G-AE

Door Frames; G-AE

Door Hardware; G-AE

Door Frame Sound Infill; G-AE

Intumescent Seals and Gasketing; G-AE

Thresholds; G-AE

Astragals; G-AE

SD-06 Test Reports

Wind Loading Tests; G-RO

Water Leakage Tests; G-RO

Acoustical Tests; G-RO

Air Infiltration Tests; G-RO

Positive Pressure Tests; G-RO

SD-07 Certificates

Hollow Metal Sound Retardant Doors; G-RO

Wood Sound Retardant Doors; G-RO

Door Frames; G-RO

Door Hardware; G-RO

Intumescent Seals,Gasketing and Door Bottoms; G-RO

Thresholds; G-RO

Astragals; G-RO

Assembly Test Reports

## 1.3 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.

### 1.3.1 Compliance and Labeling

#### 1.3.1.1 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

1.3.1.2 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.

1.3.1.3 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.

1.3.1.4 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

g. 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.

1.4 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 one 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.

1.5 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; intumescent seals and gasketing; thresholds; and astragals.

Provide assemblies that are complete with metal frame, wood door(s), sealing system, and Cam-lift hinges (when required).

2.1.1 Design Requirements

2.1.1.1 Door Design

Provide sound Retardant Wood 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 STC performance. Provide face veneer species cut and color as selected from manufacturer's full range of available colors and patterns. 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 3/4-hour C label fire rating and the specified STC.

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, prefitting, 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.

a. Species: Select white birch.

b. Cut: Rotary cut.

c. Match between Veneer Leaves: Book match.

2.2.3 Door Finishing

Conform factory finishing of Sound Retardant Wood Swinging Doors in accordance with AWI Quality Standards. Provide factory finish of a water-base stain and ultraviolet (UV) cured polyurethane sealer to comply with EPA Title 5 guidelines for Volatile Organic Compound (VOC) emissions

limitations. Conform finish to meet or exceed performance standards of NAAWS 3.1 catalyzed polyurethane.

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/A1008Mor 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; cam-lift 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 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.

2.3.7 Door Bottoms

Neoprene or silicone gasket held in place by metal housing; mortised into bottom edge of door.

2.3.7.1 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.

2.3.8 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.

Provide hardwood thresholds where indicated made of clear, all-heartwood, free of streaks, pin or worm holes, uniform in color, free of defects, finish sanded, and ready for job site, transparent or paint finish.

2.3.9 Astragals

Provide steel astragals for the inactive leaf of each pair of doors, as indicated. Surface mount to the door by welded connections or by countersunk, flat-head screws, within integral groove to receive perimeter seal material.

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. Wind Loading Tests

b. Water Leakage Tests

c. Acoustical Tests

d. Air Infiltration Tests

e. 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 wood doors and frames in accordance with NFPA 80.

Install components to manufacturer's written instructions. Coordinate with 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.

-- End of Section --

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ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
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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.

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

| | |
|---|---|
| AAMA 501 | (2015) Methods of Test for Exterior Walls |
| AAMA 800 | (2016) Voluntary Specifications and Test Methods for Sealants |
| 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 |

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 B221 | (2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes |
| 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 E330/E330M | (2014; R 2021) Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference |

| | |
|---|---|
| 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 E783 | (2002; R 2018) Standard Test Method for Field Measurement of Air Leakage Through Installed Exterior Windows and Doors |
| ASTM E1105 | (2015) Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference |
| ASTM E1424 | (1991; R 2016) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure and Temperature Differences Across the Specimen |
| 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 |

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

| | |
|---|---|
| ANSI/BHMA A156.4 | (2013) Door Controls - Closers |
| ANSI/BHMA A156.10 | (2017) Power Operated Pedestrian Doors |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IBC | (2018) International Building Code |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS TT-P-645 | (Rev C; Notice 1) Primer, Paint, Zinc-Molybdate, Alkyd Type |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 325 | (2017; Reprint Feb 2020) UL Standard for Safety Door, Drapery, Gate, Louver, and Window Operators and Systems |

## 1.2 ADMINISTRATIVE REQUIREMENTS

### 1.2.1 Pre-Installation Meetings

Conduct a meeting before installation begins to verify the project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements.

Within 30 days of the Contract Award, submit the following for review and approval by the Contracting Officer:

a. List of product installations

b. Sample warranty

c. Finish and color samples

d. Manufacturer's catalog data

Concurrently submit certified test reports showing compliance with specified performance characteristics and UL 325 for the following:

a. Wind Load (Resistance) in accordance with AAMA 501

b. Condensation Resistance and Thermal Transmittance Performance Requirements in accordance with AAMA 1503

c. Water Infiltration in accordance with ASTM E331

## 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

Sample Warranty; G-RO

List of Product Installations; G-RO

SD-02 Shop Drawings

Installation Drawings; G-AE

Fabrication Drawings; G-AE

SD-03 Product Data

Manufacturer's Catalog Data; G-AE

Finish; G-AE

Recycled Content of Aluminum Material

SD-04 Samples

Finish and Color Samples; G-AE

SD-06 Test Reports

Certified Test Reports; G-RO

Deflection

Air Infiltration

Condensation Resistance and Thermal Transmittance

Water Infiltration

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-11 Closeout Submittals

Manufacturer's Product Warranty

## 1.4 QUALITY CONTROL

### 1.4.1 Qualifications

#### 1.4.1.1 Installer Qualifications

Provide documentation of the installer's experience in performing the work specified in this section.

Ensure that the installers are specialized in work similar to that required for this project, and that they are acceptable to product manufacturer.

#### 1.4.1.2 Manufacturer Qualifications

Ensure that manufacturers meet the requirements specified in this section and project drawings.

Ensure that the manufacturer is capable of providing field service representation during construction, approving acceptable installers and approving application methods.

### 1.4.2 Single-Source Responsibility

When aluminum entrances are part of a building enclosure system, that includes storefront framing, windows, a curtain wall system, and related products, provide building enclosure system products from a single-source manufacturer.

Use a single source manufacturer with sole responsibility for providing design, structural engineering, and custom fabrication for door portal systems and for supplying components, materials, and products. Do not use products provided from numerous sources for assembly at the site. Ensure that the following work items and components are fabricated or supplied by a single source are:

a. Door assemblies to be installed in door portals as specified in Section 08 11 16 ALUMINUM DOORS AND FRAMES.

b. Glazed walls to be constructed around door portals as specified in this Section.

c. Door operating hardware to be installed on or within door portals as specified in Section 08 71 00 DOOR HARDWARE.

d. Glass as specified in Section 08 81 00 GLAZING.

## 1.5 DELIVERY, STORAGE, AND HANDLING

### 1.5.1 Ordering

To avoid construction delays, comply with the manufacturer's lead-time requirements and instructions for ordering.

### 1.5.2 Packing, Shipping, Handling and Unloading

Deliver materials in the manufacturer's original, unopened, undamaged containers with identification labels intact.

### 1.5.3 Storage and Protection

Store materials in a way that protects them from exposure to harmful weather conditions. Avoid damaging the storefront material and components during handling. Protect storefront material against damage from elements, construction activities, and other hazards before, during, and after storefront installation.

Do not use adhesive papers or sprayed coatings that become firmly bonded when exposed to sunlight. Do not leave coating residue on surfaces.

## 1.6 PROJECT / SITE CONDITIONS

### 1.6.1 Field Measurements

Verify actual measurements or openings by taking field measurements before fabrication; record these measurements on shop drawings. To avoid construction delays, coordinate field measurements, and fabrication schedule with construction progress.

## 1.7 WARRANTY

Provide a written manufacturer's warranty, executed by a company official, warranting against defects in materials and products for 2 years from the date of shipment. Warrant that the door corner construction is for the life of the project. Provide a written installer's warranty, warranting work to be watertight and free from defective materials, defective workmanship, and glass breakage as a result of defective design, and agreeing to replace components that fail within 2 years.

The warranty states the following:

a. Watertight and airtight system installation is completed within specified tolerances.

b. The completed installation remains free of rattles, wind whistles and noise caused by thermal movement and wind pressure.

c. System is structurally sound and free from distortion.

d. Glass and glazing gaskets will not break or "pop" from frames as a result of design, wind load pressure, movement caused by expansion or contraction, or structural loading.

e. Glazing sealants and gaskets remain free of abnormal deterioration or dislocation as a result of sunlight, weather, or oxidation.

Provide written warranty stating that the organic coating finish will not fade more than 10 percent or show chalking, yellowing, peeling, cracking, pitting, corroding or variations in color, or gloss deterioration beyond the manufacturer's descriptive standards for 10 years from the shipment date and agreeing to promptly correct defects.

Provide a written thermal integrity warranty for 2 years from ship date against thermal barrier system failure resulting from the following:

a. Longitudinal and transverse thermal barrier shrinkage.

b. Thermal barrier cracking.

c. Structural failure of the thermal barrier material.

d. Loss of adhesion or loss of prescribed edge pressure on glazing material, resulting in excessive air and water infiltration.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

Provide aluminum entrances, with glass and glazing, door hardware, and components.

Aluminum entrances include impact resistance entrances; medium stile, 3 1/2 inch vertical face dimension, 1 3/4 inch depth, for interior structural silicone glaze, for high-traffic/impact-resistant applications.:

#### 2.1.1 Design Requirements for Aluminum (Entrances and Components)

Provide a door portal system designed to withstand the following loads without breakage, loss, failure of seals, product deterioration, or other defects.

a. Dead and Live Loads: Determined by ASCE 7-16 and calculated in accordance with applicable codes.

b. Seismic Loads: Design and install the system to comply with the seismic requirements for the project location in accordance with Section 1613 of the International Building Code, ICC IBC.

c. Wind Loads: Design and install the system so that the effects of wind load acting inward and outward normal to the plane of the wall are in accordance with ASTM E330/E330M.

d. Thermal Loads And Movement:

(1) Ambient Temperature Range: 120 degrees F

(2) Material Surfaces Range: 180 degrees F

e. Water and Air Resistance: Provide weatherstripping, exterior gaskets, sealants, and other accessories to resist water and air penetration.

f. Impact-Protective Systems Provide an impact-protective system in accordance with ASTM E1886 ASTM E1996.

2.1.1.1 Material Standard

ASTM B221; 6063-T5 alloy and tempered.

Provide door stile and rail face dimensions of the entrance doors as follows:

| Vertical Stile | Top Rail | Bottom Rail |
|---|---|---|
| 3-1/2 inches | 3-1/2 inches | 6-1/2 inches |

Provide major portions of the door members at 0.125 inches nominal in thickness and glazing molding at 0.050 inches thick.

2.1.1.2 Recycled Content

Provide aluminum framed entrances and storefronts that have a minimum of 20 percent recycled content based upon the aluminum billet used in the original material. Provide data indicating percentage of recycled content of aluminum material.

2.1.1.3 Sealants

Provide either ethylene propylene diene monomer (EPDM) elastomeric extrusions or thermoplastic elastomer glazing gaskets. Structural silicone sealant is required.

Internal Sealants: Provide sealants that according to the manufacturer will remain permanently elastic, tacky, non-drying, non-migrating, and weather tight.

2.1.1.4 Thermal Barrier

Use a rigid, structural thermal barrier to separate all exterior aluminum from interior aluminum. For purposes of this specification, a structural thermal barrier is defined as a system that transfers shear during bending and, therefore, promotes composite action between the exterior and interior extrusions. Do not use a nonstructural thermal barrier. Ensure that the thermal barrier provides a structural connection between the two sides of the door.

2.2 FABRICATION

Provide the following information when submitting fabrication drawings for custom fabrications:

a. Indicate elevations, detailed design, dimensions, member profiles, joint locations, arrangement of units, and member connections.

b. Show the following items:

(1) Details of special shapes.

(2) Reinforcing.

(3) Anchorage system.

(4) Interfacing with building construction.

(5) Provisions for expansion and contraction.

(6) Thermal breaks.

c. Indicate typical glazing details, locations of various types and thickness of glass, emergency breakout locations, and internal sealant requirements as recommended by the sealant manufacturer.

d. Clearly indicate locations of exposed fasteners and joints.

e. Clearly show where and how the manufacturer's system deviates from Contract drawings and these specifications.

2.2.1 Entrance System Fabrication

Provide door corner construction consisting of mechanical clip fastening, SIGMA deep penetration plug welds and 1 1/8 inch long fillet welds inside and outside all four corners. Provide a hook-in type exterior glazing stop with EPDM glazing gaskets reinforced with non-stretchable cord. Provide an interior glazing stop that is mechanically fastened to the door member and that incorporates a silicone-compatible spacer used with silicone sealant.

Accurately fit and secure joints and corners. Make joints hairline in appearance. Remove burrs and smooth edges. Prepare components with internal reinforcement for door hardware. Arrange fasteners and attachments so that they are concealed from view.

Separate dissimilar metals with protective coating or pre-formed separators to prevent contact and corrosion.

2.2.2 Shop Assembly

Fabricate and assemble units with joints only at the intersection of aluminum members with hairline joints; rigidly secure these units, and seal them in accordance with the manufacturer's recommendations.

2.2.2.1 Welding

Conceal welds on aluminum members in accordance with AWS recommendations or methods recommended by the manufacturer. Members showing welding bloom or discoloration on finish or material distortion will be rejected by the Contacting Officer.

2.2.3 Finish

Before fabrication, clean the units and give them aAA-M-10-C22-A42 (color) anodized finish in accordance with the requirements of the AA DAF45. The finish thickness is A42, 0.7 mil or greater.

a. Organic Coating (high-performance exterior coating):

(1) Comply with requirements of AAMA 2605.

(2) Clean surfaces and pretreat them with a conversion coating before applying 0.3 mil dry-film thickness of epoxy or acrylic primer according to the recommendations of the finish coat manufacturer.

(3) Apply a finish coat of 70 percent minimum fluoropolymer resin fused to primed surfaces at the temperature recommended by the manufacturer and at a minimum dry film thickness of 1.0 mil.

(4) Use a 3-, or 4-coat system as required for the color selected.

2.2.4 Fabrication Tolerance

Fabricate and assemble units with joints only at intersection of aluminum members with hairline joints; rigidly secure these units, and seal them in accordance with the manufacturer's recommendations.

Fabricate aluminum entrances in accordance with the entrance manufacturer's prescribed tolerances.

2.2.4.1 Material Cuts

Square to 1/32 inch off square, over largest dimension; proportionate amount of 1/32 inch on the two dimensions.

2.2.4.2 Maximum Offset at Consecutive Members

1/64 inch in alignment between two consecutive members in line, end to end.

2.2.4.3 Maximum Offset at Glazing Pocket Corners

1/64 inch between framing members at glazing pocket corners.

2.2.4.4 Joints

Between adjacent members in same assembly: Joints are hairline and square to the adjacent member.

2.2.4.5 Variation

In squaring diagonals for doors and fabricated assemblies: 1/16 inch.

2.2.4.6 Flatness

For doors and fabricated assemblies: plus/minus 1/16 inch of neutral plane.

2.3 MATERIALS

2.3.1 Sealants

Ensure that all sealants conform to AAMA 800.

2.3.2 Glass

Refer to Section 08 81 00 GLAZING.

## 2.4 ACCESSORIES

### 2.4.1 Fasteners

Provide stainless steel fasteners in areas where the fasteners are exposed.

Use non-corrosive and compatible fasteners with components being fastened. Do not use exposed fasteners, except where unavoidable for application of hardware.

In areas where fasteners are not exposed, use aluminum, non-magnetic stainless steel, or other materials warranted by the manufacturer.

For exposed locations, provide countersunk Phillips head screws when items with a matching finish are fastened. For concealed locations, provide the manufacturer's standard fasteners.

Provide nuts or washers that have been designed with a means to prevent disengagement; do not deform fastener threads.

### 2.4.2 Perimeter Anchors

When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

#### 2.4.2.1 Inserts and Anchorage Devices

Provide manufacturer's standard formed or fabricated assemblies, steel or aluminum, of shapes, plates, bars, or tubes. Shop-coat steel assemblies after fabrication with an alkyd zinc chromate primer complying with FS TT-P-645.

### 2.4.3 Standard Entrance Hardware

#### 2.4.3.1 Weatherstripping

Equip meeting stiles on pairs of doors with an adjustable astragal using wool pile with a polymeric fin.

Provide door weatherstripping on a single-acting offset pivot or butt-hung door and frame (single or pairs) consisting of a thermoplastic elastomer weatherstripping on a tubular shape with a semi-rigid polymeric backing.

Provide sill-sweep strips: Provide an EPDM blade gasket sweep strip in an aluminum extrusion applied to the interior exposed surface of the bottom rail with concealed fasteners. (Provide as necessary to meet specified performance tests.)

#### 2.4.3.2 Threshold

Provide an extruded aluminum threshold, one piece per door opening, with ribbed surface.

#### 2.4.3.3 Offset Pivots

Provide the manufacturer's standard top and bottom pivots with one intermediate offset pivot.

2.4.3.4 Panic Device

Provide the manufacturer's recommended standard panic hardware.

2.4.3.5 Closer

Provide a surface closer in accordance with ANSI/BHMA A156.4.

2.4.3.6 Security Lock or Dead Lock

Provide A/R MS 1850A lock with two A/R 1871 cylinder operated flush bolts.

2.4.3.7 Cylinder(s)/Thumb-turn

Provide the manufacturer's recommended standard.

2.4.3.8 Cylinder Guard

Provide the manufacturer's recommended standard.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Site Verification of Conditions

Verify that the condition of substrate previously installed under other sections is acceptable for product installation in accordance with the manufacturer's instructions.

Verify that openings are sized to receive the storefront system and that the sill plate is level in accordance with the manufacturer's acceptable tolerances.

3.2 PREPARATION

Field-verify dimensions before fabricating components for the door portal assembly.

Coordinate requirements for locations of blockouts for anchorage of door portal columns and other embedded components with Section 03 30 00 CAST-IN-PLACE CONCRETE.

Coordinate the erection of door portal with installation of surrounding glass wall and door assemblies. Ensure that the door portals can provide support and anchorage for assembly components.

Coordinate electrical requirements for electrified door hardware to ensure proper power source, conduit, wiring, and boxes.

3.2.1 Adjacent Surfaces Protection

Protect adjacent work areas and finish surfaces from damage during product installation.

3.2.2 Aluminum Surface Protection

Protect aluminum surfaces from contact with lime, mortar, cement, acids, and other harmful contaminants.

## 3.3 INSTALLATION

Submit installation drawings for review and approval.

Install the entrance system in accordance with the manufacturer's instructions and the AAMA storefront and entrance guide specifications manual. Attach the entrance system to the structure, allowing it to be adjusted to accommodate construction tolerances and other irregularities. Provide alignment attachments and shims to permanently fasten the system to the building structure. Align the assembly so that it is plumb and level, and free of warp and twist. Maintain assembly dimensional tolerances aligning with adjacent work.

Set thresholds in a bed of mastic and secure the thresholds. Protect aluminum members in contact with masonry, steel, concrete, or dissimilar materials using nylon pads or a bituminous coating. Shim and brace the aluminum system before anchoring the system to the structure. Verify that weep holes are open, and the metal joints are sealed in accordance with the manufacturer's installation instructions. Seal metal-to-metal joints using a sealant recommended by the system manufacturer.

### 3.3.1 Tolerances

Ensure that tolerances for wall thickness and other cross-sectional dimensions of entrance members are nominal and in compliance with Aluminum Standards and Data, published by the Aluminum Association.

### 3.3.2 Adjusting

Adjust operating hardware for smooth operation, and as recommended by the manufacturer.

### 3.3.3 Related Products Installation Requirements

#### 3.3.3.1 Sealants (Perimeter)

Refer to Section 07 92 00 JOINT SEALANTS.

#### 3.3.3.2 Glass

Refer to Section 08 81 00 GLAZING.

## 3.4 FIELD QUALITY CONTROL

### 3.4.1 Air Infiltration

Test air infiltration in accordance with ASTM E783

Submit certified test reports showing compliance with specified performance characteristics as follows:

a. For single-acting offset pivot, butt hung, or continuous geared hinge entrances in the closed and locked position, test the specimen in accordance with ANSI/BHMA A156.10, and ASTM E283 at a pressure differential of 1.57 psf for pairs of doors; ensure that maximum infiltration for a pair of 7 foot by 8 foot entrance doors and frame is 1.2 cfm/square foot.

b. Ensure the maximum allowable infiltration for a completed storefront system does not exceed 0.06 cfm/square foot when tested in accordance with ASTM E1424 at a differential static pressure of 6.24 psf.

3.4.2 Wind Loads

Provide a completed storefront system capable of withstanding wind pressure loads, normal to the wall plane indicated, as follows:

a. Exterior Walls

(1) Positive Pressure: As indicated on drawings.

(2) Negative Pressure: As indicated on drawings

b. Interior Walls: (pressure acting in either direction) 5 psf

3.4.3 Deflection

Submit certified test reports showing that the maximum allowable deflection in a member when tested in accordance with ASTM E330/E330M with allowable stress is L/175 or 3/4 inches maximum.

3.4.4 Condensation Resistance and Thermal Transmittance

Submit certified test reports showing compliance with specified performance characteristics as follows:

a. U-Value Requirements:

(1) Perform test in accordance with the AAMA 1503 procedure and on the configuration specified therein.

(2) Thermal Transmittance ("U" Value) maximum 0.65 (6250) BTU/hr/sf/deg F at 15 mph exterior wind.

b. CRF Class Requirements:

(1) Perform a test in accordance with AAMA 1503.

3.4.5 Water Infiltration

Submit certified test reports showing that the system is designed to provide no uncontrolled water when tested in accordance with ASTM E1105 at a static pressure of 8 psf.

3.5 ADJUSTING AND CLEANING

3.5.1 Protection

Protect the installed product's finish surfaces from damage during construction. Protect the aluminum storefront system from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants.

3.5.2 Cleaning

Repair or replace damaged installed products. Clean installed products in

accordance with manufacturer's instructions before acceptance remove excess mastic, mastic smears, and other foreign materials. Remove construction debris from the project site and legally dispose of this debris.

3.6 WARRANTY

Submit three signed copies of the manufacturer's product warranty for the entrance system as follows:

a. Warranty Period: Five years from Date of Substantial Completion of the project, provided that the Limited Warranty begins no later than six months from the date of shipment by the manufacturer. In addition, support welded door corner construction with a limited lifetime warranty for the life of the door under normal use.

Ensure that the Warranty's language is identical to the "As Approved" version of the sample warranty submitted to and returned from the Contracting Officer.

-- End of Section --

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SECTION 08 71 00

DOOR HARDWARE
**02/16, CHG 4: 02/22**

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 |

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

| | |
|---|---|
| ANSI/BHMA A156.1 | (2021) Butts and Hinges |
| ANSI/BHMA A156.3 | (2020) Exit Devices |
| ANSI/BHMA A156.4 | (2013) Door Controls - Closers |
| ANSI/BHMA A156.6 | (2021) Architectural Door Trim |
| ANSI/BHMA A156.7 | (2016) Template Hinge Dimensions |
| ANSI/BHMA A156.8 | (2021) Door Controls - Overhead Stops and Holders |
| ANSI/BHMA A156.10 | (2017) Power Operated Pedestrian Doors |
| ANSI/BHMA A156.13 | (2017) Mortise Locks & Latches Series 1000 |
| ANSI/BHMA A156.16 | (2018) Auxiliary Hardware |
| ANSI/BHMA A156.18 | (2020) Materials and Finishes |
| ANSI/BHMA A156.21 | (2019) Thresholds |
| ANSI/BHMA A156.22 | (2021) Door Gasketing and Edge Seal Systems |
| 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 |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |
| NFPA 72 | (2022) National Fire Alarm and Signaling Code |
| NFPA 80 | (2022) Standard for Fire Doors and Other Opening Protectives |
| NFPA 101 | (2021) Life Safety Code |
| NFPA 252 | (2022) 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 |

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 |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL Bld Mat Dir | (updated continuously online) Building Materials 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

Manufacturer's Detail Drawings; G-AE

Verification of Existing Conditions; G-AE

Hardware Schedule; G-AE

Keying System; G-AE

SD-03 Product Data

Hardware Items; G-AE

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1; G-RO

SD-11 Closeout Submittals

Key Bitting

1.3 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.

1.4 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.

1.5 HARDWARE SCHEDULE

Provide Hardware Item List and Hardware Schedule containing the following information, and additional information as needed to identify the complete make up of each hardware set and its application to each opening:

1.5.1 Hardware Item List:

a. Hardware Type

b. Item Number

c. Quantity

d. Size(s)

e. Reference Publication / Type Number

f. Manufacturer's Name / Catalog Number

g. Key Control Symbols

h. UL Mark (If fire rated and listed)

i. BHMA Finish(es)

j. Remarks

1.5.2 Hardware Schedule

a. Hardware Set Number

b. Opening Number(s)

c. Opening Description (single/double leaf, hand, size, door/frame material)

d. Fire Rating

e. Sound Rating

f. Hardware Items

g. Quantity

h. Size

i. BHMA Finish

j. Remarks

In addition, submit hardware schedule data package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

## 1.6 KEY BITTING CHART REQUIREMENTS

### 1.6.1 Requirements

Submit key bitting charts to the Contracting Officer prior to completion of the work. Include:

a. Complete listing of all keys (e.g. AA1 and AA2).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

## 1.7 QUALITY ASSURANCE

### 1.7.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, and closers of one lock, hinge, or closer manufacturer's make. Modify hardware as necessary to provide features indicated or specified.

### 1.7.2 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.

## 1.8 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.

##### 2.3.1.1 Protection Devices

Provide full height hand and finger protection device at the hinge-side area opening of doors and gates. Provide hinge-side protection devices on both sides of doors and gates, covering hinges and space between door and frame when doors are in the open position. The installed device must push hand and fingers out of the opening and away from a crushing hazard.

#### 2.3.2 Continuous Hinges

Where continuous hinges are required, provide in accordance with ANSI/BHMA A156.26.

#### 2.3.3 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.

2.3.3.1 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 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.

2.3.5 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 outside control key. Provide door alarms integrated with the fire alarm system in accordance with NFPA 72.

2.3.6 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Provide cylinders and cores with pin tumblers to match existing base standards. 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.

Provide cylinders for new locks, including locks provided under other sections of this specification. Provide fully compatible cylinders of Grade 1 products from products of one manufacturer with interchangeable cores that are removable by a special control key. Submit a core code sheet with the cores. Provide master keyed cores in one system for this project. Provide construction interchangeable cores.

2.3.6.1 High Security Cylinders

Provide in accordance with ANSI/BHMA A156.30, security level to match existing base standards for all high security cylinder components.

2.3.7 Electrified Hardware

Comply with the requirements of NFPA 70 for wiring of electrified hardware.

2.3.7.1 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, resisters, and signal switches in accordance with paragraph ELECTRIC STRIKES AND FRAME MOUNTED ACTUATORS.

2.3.7.1.1 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.

2.3.7.2 Power Operated Pedestrian Door Hardware

Provide in accordance with ANSI/BHMA A156.10, Grade 1.

2.3.8 Keying System

Provide an extension of the existing keying system. Existing locks w have interchangeable cores. Provide a construction master keying system construction interchangeable cores.

Provide cylinders of Grade 1 products from one manufacturer. Notify the Contracting Officer 90 days prior to the required delivery of the cylinders. Provide temporary cores and keys for the Contractor's use during construction, and for testing of locksets.

2.3.9 Lock Trim

Provide cast, forged, or heavy wrought construction and commercial plain design for lock trim to match existing base standards.

2.3.9.1 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.

2.3.10 Keys

Furnish one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system. Furnish one additional working key for each lock of each keyed-alike group. Furnish 5 great grand master keys,10 construction master keys, and 2 control keys for removable cores. Furnish 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.

2.3.11 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, 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.

2.3.11.1 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.

2.3.12 Overhead Holders

Provide in accordance with ANSI/BHMA A156.8.

2.3.13 Door Protection Plates

Provide in accordance with ANSI/BHMA A156.6.

2.3.13.1 Sizes of 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.

2.3.14 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.

2.3.15 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.

2.3.16 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:

2.3.16.1 Extruded Aluminum Retainers

Extruded aluminum retainers not less than 0.050 inch wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Provide clear (natural) anodized aluminum.

2.3.17 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, clear (natural) 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.

2.3.18 Rain Drips

Provide in accordance with ANSI/BHMA A156.22. Provide extruded aluminum rain drips, not less than 0.08 inch thick, bronze anodized finish. 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.

2.3.18.1 Door Rain Drips

Approximately 1-1/2 inch high by 5/8 inch projection. Align bottom with bottom edge of door.

2.3.18.2 Overhead Rain Drips

Approximately 1-1/2 inch high by 2-1/2 inch projection. Align bottom with door frame rabbet.

2.3.19 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 600 finish (primed for painting) 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.

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 and Armor 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.

| **MANUFACTURER ABBREVIATIONS** | |
|---|---|
| MK | McKinney |
| PE | Pemko |
| RO | Rockwood |
| SA | SARGENT |
| RF | Rixson |
| NO | Norton |
| OT | Other |
| HD | HID |
| SU | Securitron |

| **Set: 1.0** | | | |
|---|---|---|---|
| Doors: 1000A, 1000B | | | |
| 1 | Continuous Hinge (A31031G) | CFM (height) HD1 (Size as Required) | |
| 1 | Rim Exit Device (Type 4, 08) | Narrow Rim Exit Device - Classroom Trim, Cyl. Dogging | US32D |
| 2 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 2 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Surface Closer (C02021-PT4G) | Surface Closer - HD PA STP Arm | 689 |
| 1 | Threshold (J36130) | 6 1/8" X 1/4" Thermally Broken Grooved Threshold W/SS Fasteners and Anchors | |
| 1 | Drip Strip (R0Y976) | Clear Anodized Aluminum 2 1/2" Screw Appied Rain Drip | |
| 1 | Door Bottom Seal (R0Y416) | 1 1/4" Clear Anodized Aluminum Door Sweep W/Neoprene Sweep Gasket | |

| | | | |
|---|---|---|---|
| Notes: Perimeter Weatherstrip by the Aluminum Door Manufacturer. | | | |
| | | | |
| **Set: 2.0** | | | |
| Doors: 1025, 1038 | | | |
| 2 | Hinge (A5111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US32D |
| 1 | Electric Hinge (A5111) | Hvy Weight Mortised Butt HInge - Power Transfer - (Size as Required) | US32D |
| 1 | FF-L-2890 Egress Devise | Type 10 Exit Devise, Exit Only Device | US32D |
| 1 | Surface Closer (C02021-PT4G) | Surface Closer - HD PA STP Arm | 689 |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Threshold (J36130) | 6 1/8" X 1/4" Thermally Broken Grooved Threshold W/SS Fasteners and Anchors | |
| 1 | Drip Strip (R0Y976) | Clear Anodized Aluminum 2 1/2" Screw Appied Rain Drip | |
| 1 | Gasketing (R3E165) | Screw Applied 1 1/2" X 1/4" Perimeter Gasket W/Neoprene Bulb Gasket (head & jambs) | |
| 1 | Door Bottom Seal (R0Y416) | 1 1/4" Clear Anodized Aluminum Door Sweep W/Neoprene Sweep Gasket | |
| 1 | Door Wire Harness | Door Wire Harness with Modular Adapter (Length / Type as Required) | |
| 1 | Frame Wire Harness | 15' Frame Wire Harnes with Modular adapter | |
| 1 | High Security Switch | HSS (High Security Door Position Switch) | |
| 1 | Wiring Diagram | Complete with point to point drawing | |
| Notes: Exit Only, No Exterior hardware or access.<br><br>Operation: High Security Door position switch will signal the doors OPEN/CLOSED status to the access control panel. | | | |
| | | | |
| **Set: 3.0** | | | |

| | | | |
|---|---|---|---|
| Doors: 1048, 1049 | | | |
| 6 | Hinge (A5111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US32D |
| 1 | Self Latch Flush Bolt Set (A156.3, Type 25) | Automatic Flushbolt | US26D |
| 1 | Dust Proof Strike (L04021) | Dustproof Flushbolt Strike | US26D |
| 1 | Storeroom Lock (F07) | Mortised Storeroom Lock W/Lever Handles | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 2 | Surface Closer (C02021-PT4G) | Surface Closer - HD PA STP Arm | 689 |
| 2 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Threshold (J32130) | 5" X 1/2" Grooved Threshold W/SS Fasteners and Anchors | |
| 1 | Drip Strip (R0Y976) | Clear Anodized Aluminum 2 1/2" Screw Appied Rain Drip | |
| 1 | Gasketing (R3E165) | Screw Applied 1 1/2" X 1/4" Perimeter Gasket W/Neoprene Bulb Gasket (head & jambs) | |
| 2 | Door Bottom Seal (R0Y416) | 1 1/4" Clear Anodized Aluminum Door Sweep W/Neoprene Sweep Gasket | |
| 2 | Astragal Set (R0Y835) | Aluminum Meeting Stile Astragals W/Silicone Bulb Gasket | |
| Notes: EXISTING DOORS AND FRAMES. Verify Existing Hardware Preps; ensure that replacement hardware will match existing hardware preps. revise/repair/replace as required. | | | |
| | | | |
| **Set: 4.0** | | | |
| Doors: 1014A | | | |
| 6 | Hinge (A5111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US32D |
| 1 | Self Latch Flush Bolt Set (A156.3, Type 25) | Automatic Flushbolt | US26D |
| 1 | Dust Proof Strike (L04021) | Dustproof Flushbolt Strike | US26D |

| | | | |
|---|---|---|---|
| 1 | Storeroom Lock (F07) | Mortised Storeroom Lock W/Lever Handles | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 2 | Surface Closer (C02021-PT4G) | Surface Closer - HD PA STP Arm | 689 |
| 2 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Threshold (J32130) | 5" X 1/2" Grooved Threshold W/SS Fasteners and Anchors | |
| 1 | Drip Strip (R0Y976) | Clear Anodized Aluminum 2 1/2" Screw Appied Rain Drip | |
| 1 | Gasketing (R3E165) | Screw Applied 1 1/2" X 1/4" Perimeter Gasket W/Neoprene Bulb Gasket (head & jambs) | |
| 2 | Door Bottom Seal (R0Y416) | 1 1/4" Clear Anodized Aluminum Door Sweep W/Neoprene Sweep Gasket | |
| 2 | Astragal Set (R0Y835) | Aluminum Meeting Stile Astragals W/Silicone Bulb Gasket | |
| 2 | High Security Switch | High Security Switch Metal / Wood (as required) | |
| Operation: High Security switches at each leaf will signal the doors OPEN/CLOSED status to the access control panel. | | | |
| | | | |
| **Set: 5.0** | | | |
| Doors: 1014B | | | |
| 3 | Hinge (A5111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US32D |
| 1 | Storeroom Lock (F07) | Mortised Storeroom Lock W/Lever Handles | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Surface Closer (C02021-PT4G) | Surface Closer - HD PA STP Arm | 689 |

| | | | |
|---|---|---|---|
| 1 | Threshold (J32130) | 5" X 1/2" Grooved Threshold W/SS Fasteners and Anchors | |
| 1 | Drip Strip (R0Y976) | Clear Anodized Aluminum 2 1/2" Screw Appied Rain Drip | |
| 1 | Gasketing (R3E165) | Screw Applied 1 1/2" X 1/4" Perimeter Gasket W/Neoprene Bulb Gasket (head & jambs) | |
| 1 | Door Bottom Seal (R0Y416) | 1 1/4" Clear Anodized Aluminum Door Sweep W/Neoprene Sweep Gasket | |
| 1 | High Security Switch | High Security Switch Metal / Wood (as required) | |
| Notes: EXISTING DOOR AND FRAME. Verify Existing Hardware Preps; ensure that replacement hardware will match existing hardware preps. revise/repair/replace as required.<br><br>Operation: High Security switch will signal the doors OPEN/CLOSED status to the access control panel. | | | |
| | | | |
| **Set: 6.0** | | | |
| Doors: 1021B | | | |
| 3 | Hinge (A5111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US32D |
| 1 | Storeroom Lock (F07) | Mortised Storeroom Lock W/Lever Handles | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Surface Closer (C02021-PT4G) | Surface Closer - HD PA STP Arm | 689 |
| 1 | Threshold (J32130) | 5" X 1/2" Grooved Threshold W/SS Fasteners and Anchors | |
| 1 | Drip Strip (R0Y976) | Clear Anodized Aluminum 2 1/2" Screw Appied Rain Drip | |
| 1 | Gasketing (R3E165) | Screw Applied 1 1/2" X 1/4" Perimeter Gasket W/Neoprene Bulb Gasket (head & jambs) | |

| | | | |
|---|---|---|---|
| 1 | Door Bottom Seal (R0Y416) | 1 1/4" Clear Anodized Aluminum Door Sweep W/Neoprene Sweep Gasket | |
| 1 | High Security Switch | HSS (High Security Door Position Switch) | |

Notes: EXISTING DOOR AND FRAME. Verify Existing Hardware Preps; ensure that replacement hardware will match existing hardware preps. revise/repair/replace as required.

Operation: High Security Door position switch will signal the doors OPEN/CLOSED status to the access control panel.

**Set: 7.0**

Doors: 1040

| | | | |
|---|---|---|---|
| 8 | Hinge (A8111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |
| 1 | Removable Mullion (Type 22) | Fire Rated Steel Keyed Removable Mullion | PC |
| 2 | FF-L-2890 Exit Only | Type 10 Exit Device, Exit Only | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 2 | Surface Closer (C02021-PT4G) | Surface Closer - HD PA STP Arm | 689 |
| 2 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Threshold (J32300) | 2-1/4" X 3/16" Smooth Threshold W/SS Fasteners and Anchors | |
| 1 | Adhesive Mullion Gasketing (ROC004) | Adhesive Applied Removable Mullion Gasket x Mullion Height | |
| 1 | Sound Seals | Sound Seals to meet 50 STC by Door / Frame Manufacturer | |
| 2 | High Security Switch | HSS (High Security Door Position Switch) | |

Operation: High Security Door position switch will signal the doors OPEN/CLOSED status to the access control panel.

| | | | |
|---|---|---|---|
| | | | |
| **Set: 8.0** | | | |
| Doors: 1011, 1037A, 1037B | | | |
| 3 | Hinge (A8111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |
| 1 | Passage Latch (F01) | Mortis passage latch with lever handles | US32D |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 3 | Silencer (L03011) | Hollow Metal Frame Silencer | |
| | | | |
| **Set: 9.0** | | | |
| Doors: Mot Used | | | |
| | | | |
| **Set: 10.0** | | | |
| Doors: 1030, 1041 | | | |
| 3 | Hinge (A8111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |
| 3 | Electric Hinge (A8111) | Hvy Weight Mortised Butt Hinge - Power Transfer - (Size as Required) | US26D |
| 1 | Fail Secure Electric Lock (F07, E01, E06) | Electrified Mortised Storeroom Lock W/Lever Handles - RX - 24VDC | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |

| | | | |
|---|---|---|---|
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 3 | Silencer (L03011) | Hollow Metal Frame Silencer | |
| 1 | Card Reader | HID RP40 Card Reader - By Access Control | BLK |
| 1 | Door Wire Harness | Door Wire Harness with Modular Adapter (Length / Type as Required) | |
| 1 | Frame Wire Harness | 15' Frame Wire Harnes with Modular adapter | |
| 1 | High Security Switch | HSS (High Security Door Position Switch) | |
| 1 | Power Supply | Power Supply (size & type as required) | |
| 1 | Wiring Diagram | Complete with point to point drawing | |

Notes: Coordinate all Wiring and conduit with electrical contractor.

Operation: Door is normally closed and secure. When a proper credential is presented to the Card Reader (by access control) the lever on the keyed side of the opening will be momentarily released to allow entry. The lever on the unsecured side is free at all times for egress. Request to Exit Switch integrated in lockset will notify access control of authorized egress. Key will retract latch in case of emergency. High Security Door position switch will signal the doors OPEN/CLOSED status to the access control panel. Lock is Fail Secure and will remain locked in the event of a fire emergency or power outage.

**Set: 11.0**

Doors: Not Used

**Set: 12.0**

Doors: 2013, 3013

| | | | |
|---|---|---|---|
| 2 | Hinge (A8111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |
| 1 | Electric Hinge (A8111) | Hvy Weight Mortised Butt Hinge - Power Transfer - (Size as Required) | US26D |
| 1 | Fail Secure Electric Lock (F07, E01, E06) | Electrified Mortised Storeroom Lock W/Lever Handles - RX - 24VDC | US32D |

| | | | |
|---|---|---|---|
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 1 | Gasketing (ROE154) | Adhesive Applied Perimeter Door/Frame Seal (head & jambs) | |
| 1 | Card Reader | HID RP40 Card Reader - By Access Control | BLK |
| 1 | Door Wire Harness | Door Wire Harness with Modular Adapter (Length / Type as Required) | |
| 1 | Frame Wire Harness | 15' Frame Wire Harnes with Modular adapter | |
| 1 | High Security Switch | High Security Switch Metal / Wood (as required) | |
| 1 | Power Supply | Power Supply (size & type as required) | |
| 1 | Wiring Diagram | Complete with point to point drawing | |

Notes: Coordinate all Wiring and conduit with electrical contractor.

Operation: Door is normally closed and secure. When a proper credential is presented to the Card Reader (by access control) the lever on the keyed side of the opening will be momentarily released to allow entry. The lever on the unsecured side is free at all times for egress. Request to Exit Switch integrated in lockset will notify access control of authorized egress. Key will retract latch in case of emergency. High Security switch will signal the doors OPEN/CLOSED status to the access control panel. Lock is Fail Secure and will remain locked in the event of a fire emergency or power outage.

**Set: 13.0**

Doors: 1002B, 1013, 1039B

| | | | |
|---|---|---|---|
| 2 | Hinge (A8111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |

| | | | |
|---|---|---|---|
| 1 | Electric Hinge (A8111) | Hvy Weight Mortised Butt Hinge - Power Transfer - (Size as Required) | US26D |
| 1 | Fail Secure Electric Lock (F07, E01, E06) | Electrified Mortised Storeroom Lock W/Lever Handles - RX - 24VDC | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 1 | Threshold (J32300) | 2-1/4" X 3/16" Smooth Threshold W/SS Fasteners and Anchors | |
| 1 | Sound Seals | Sound Seals to Meet reuired STC per drawings by Door / Frame Manufacturer | |
| 1 | Card Reader | HID RP40 Card Reader - By Access Control | BLK |
| 1 | Door Wire Harness | Door Wire Harness with Modular Adapter (Length / Type as Required) | |
| 1 | Frame Wire Harness | 15' Frame Wire Harnes with Modular adapter | |
| 1 | High Security Switch | High Security Switch Metal / Wood (as required) | |
| 1 | Power Supply | Power Supply (size & type as required) | |
| 1 | Wiring Diagram | Complete with point to point drawing | |

Notes: Coordinate all Wiring and conduit with electrical contractor.

Operation: Door is normally closed and secure. When a proper credential is presented to the Card Reader (by access control) the lever on the keyed side of the opening will be momentarily released to allow entry. The lever on the unsecured side is free at all times for egress. Request to Exit Switch integrated in lockset will notify access control of authorized egress. Key will retract latch in case of emergency. High Security switch will signal the doors OPEN/CLOSED status to the access control panel. Lock is Fail Secure and will remain locked in the event of a fire emergency or power outage.

| | | | |
|---|---|---|---|
| **Set: 14.0** | | | |
| Doors: 1002A, 1039A | | | |
| 2 | Hinge (A8111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |
| 1 | Electric Hinge (A8111) | Hvy Weight Mortised Butt Hinge - Power Transfer - (Size as Required) | US26D |
| 1 | FF-L-2740B High Security Electronic Lock | Lock Masters - X-10 Lock | US32D |
| 1 | FF-L-2890 Egress Hardware | Type IV with integrated REX and key override | US32D |
| 1 | Fail Secure Electric Lock (F07, E01, E06) | Electrified Mortised Storeroom Lock W/Lever Handles - RX - 24VDC | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 1 | Threshold (J32300) | 2-1/4" X 3/16" Smooth Threshold W/SS Fasteners and Anchors | |
| 1 | Sound Seals | Sound Seals to meet required STC per drawings by Door / Frame Manufacturer | |
| 1 | Card Reader | HID RP40 Card Reader - By Access Control | BLK |
| 1 | Door Wire Harness | Door Wire Harness with Modular Adapter (Length / Type as Required) | |
| 1 | Frame Wire Harness | 15' Frame Wire Harnes with Modular adapter | |
| 1 | High Security Switch | HSS (High Security Door Position Switch) | |
| 1 | Power Supply | Power Supply (size & type as required) | |
| 1 | Wiring Diagram | Complete with point to point drawing | |

Notes: Coordinate all Wiring and conduit with electrical contractor.

Operation: Door is normally closed and secure. When the correct digital code is entered into the X10 Dial Lock and a proper credential is presented to the Card Reader (by access control) the lever on the keyed side of the opening will be momentarily released to allow entry. The lever on the unsecured side is free at all times for egress. Request to Exit Switch integrated in lockset will notify access control of authorized egress. Key will retract latch in case of emergency. High Security Door position switch will signal the doors OPEN/CLOSED status to the access control panel. Lock is Fail Secure and will remain locked in the event of a fire emergency or power outage. X10 Dial Lock is a Fail Secure and will remain locked in the event of a loss of power, lock is self-powered.

**Set: 15.0**

Doors: 2000

| | | | |
|---|---|---|---|
| 8 | Hinge (A5111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US32D |
| 1 | Self Latch Flush Bolt Set (A156.3, Type 25) | Automatic Flushbolt | US26D |
| 1 | Dust Proof Strike (L04021) | Dustproof Flushbolt Strike | US26D |
| 1 | Storeroom Lock (F07) | Mortised Storeroom Lock W/Lever Handles | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Coordinator (A156.3, Type 21) | Overhead Bar Type Coordinator | US28 |
| 2 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 2 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 2 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 2 | Silencer (L03011) | Hollow Metal Frame Silencer | |

**Set: 16.0**

Doors: 1005A, 1029, 1033

| | | | |
|---|---|---|---|
| 3 | Hinge (A8112) | Std. Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |
| 1 | Storeroom Lock (F07) | Mortised Storeroom Lock W/Lever Handles | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 3 | Silencer (L03011) | Hollow Metal Frame Silencer | |
| | | | |
| | **Set: 17.0** | | |
| Doors: 1015, 1034, 2100A, 2100B | | | |
| 3 | Hinge (A8112) | Std. Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |
| 1 | Storeroom Lock (F07) | Mortised Storeroom Lock W/Lever Handles | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Surface Closer (C02021-PT4G) | Surface Closer - HD PA STP Arm | 689 |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 3 | Silencer (L03011) | Hollow Metal Frame Silencer | |
| | | | |
| | **Set: 18.0** | | |
| Doors: 1010, 1022, 1031, 1042A | | | |
| 3 | Hinge (A8112) | Std. Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |

| | | | |
|---|---|---|---|
| 1 | Entry Lock (F04) | Mortised Entry Lock W/Lever Trim | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 3 | Silencer (L03011) | Hollow Metal Frame Silencer | |
| | | | |
| **Set: 19.0** | | | |
| Doors: 1012A, 1012B, 1021a, 1023, 1045a, 1045b, 1046 | | | |
| 3 | Hinge (A8112) | Std. Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |
| 1 | Classroom Lock (F05) | Mortised Classroom Lock w/Lever Handle | US32D |
| 1 | FSIC Core 7-Pin (E09242) | Keyed to Match Existing System | 626 |
| 1 | FSIC MORT/RIM Cylinder (E09251/E09261) | Mortised/Rim Cylinder Housing (as required) | US32D |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 3 | Silencer (L03011) | Hollow Metal Frame Silencer | |
| | | | |
| **Set: 20.0** | | | |
| Doors: 1003, 1004 | | | |
| 3 | Hinge (A8112) | Std. Weight Mortised Butt Hinge (Size and NRP as Required) | US26D |

| | | | |
|---|---|---|---|
| 1 | Privacy Set (F09) | Mortisesd Privacy Lock W/Occupancy Indicator | US32D |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 3 | Silencer (L03011) | Hollow Metal Frame Silencer | |
| | | | |
| | **Set: 21.0** | | |
| Doors: 1027, 1028 | | | |
| 3 | Hinge (A5111) | Hvy Weight Mortised Butt Hinge (Size and NRP as Required) | US32D |
| 1 | Push Plate (J301) | SS Push Plate 8" X 16" | US32D-MS |
| 1 | Pull Plate (J405) | 1" Rnd X 10" CTC SS Pull W/SS 4" X 16" Mounting Plate | US32D-MS |
| 1 | Door Closer (C02011, C02021) | Surface Mounted Closer Reg/PA Arm (as required) | EN |
| 1 | Kick Plate (J102) | 10" X 2" LDW SS Kick Plate - BEV CSK | US32D |
| 1 | Wall Stop-Convex (L02101-Cast) | Wall Stop | US26D |
| 3 | Silencer (L03011) | Hollow Metal Frame Silencer | |
| | | | |
| | **Set: 22.0** | | |
| Doors: 1006B | | | |
| 1 | BALANCE OF HARDWARE | BALANCE OF HARDWARE BY GATE MANUFACTURER | |
| | | | |
| | **Set: 23.0** | | |
| Doors: 1005B, 1006A, 1036, 1037C, 1037D, 1042B | | | |

| | | | |
|---|---|---|---|
| 1 | BALANCE OF HARDWARE | BALANCE OF HARDWARE BY OVERHEAD DOORS MANUFACTURER | |
| | | | |

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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 2021) Standard Specifiaction for 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 | (2021) 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 E90 | (2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements |
| ASTM E413 | (2022) Classification for Rating Sound Insulation |
| 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 |

## 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

Insulating Glass; G-AE

Glazing Accessories; G-AE

Sealants; G-AE

Joint Backer; G-AE

SD-04 Samples

Insulating Glass; G-AE

Glazing Compound

Glazing Tape

Sealing Tapes

SD-07 Certificates

Insulating Glass; G-RO

SD-08 Manufacturer's Instructions

Setting and Sealing Materials

Glass Setting

SD-11 Closeout Submittals

Warranty for Insulated Glass Units; G-RO

Warranty for Monolithic Opacified Spandrel

## 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.

## 1.4 QUALITY CONTROL

Submit two 8 by 10 inch samples of each of the following: insulating glass units.

Submit three samples of each other material.

## 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 above40 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 Annealed Glass

Annealed glass must be Type I transparent flat type, Class 1 - clear, Quality q3 - glazing select, conforming to ASTM C1036.

### 2.1.2 Laminated Glass

ASTM C1172, Laminated glass fabricated from two nominal 1/8 inch pieces of Type I, Class 1, Quality Q3, flat heat strengthened clear glass conforming to ASTM C1048. Flat glass to be laminated together with a minimum of 0.030 inch 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_unless otherwise indicated.

### 2.1.3 Mirrors

#### 2.1.3.1 Glass Mirrors

Glass for mirrors must be Type I transparent flat type, Class 1-clear, Glazing Quality q1 1/4 inch thick conforming to ASTM C1036. Glass must be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating must be highly adhesive pure silver coating of a thickness which must provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and must be free of pinholes or other defects. Copper protective coating must be

pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and must be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint must consist of two coats of special scratch and abrasion-resistant paint , and must be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.1.4 Tempered Glass

ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent), Quality q3, 1/4 inch thick, conforming to ASTM C1048 and GANA Standards Manual. Color must be clear unless otherwise noted.

2.1.5 Heat-Strengthened Glass

ASTM C1048, Kind HS (heat strengthened), Condition A (uncoated), Type I, Class 1 (clear), Quality q3, 1/4 inch thick.

2.1.6 Spandrel Glass

2.1.6.1 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.

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.

Glazed panels must be rated for not less than 35 Sound Transmission Class (STC) when tested for laboratory sound transmission loss according to ASTM E90 and determined by ASTM E413.

Dimensional tolerances must be as specified in IGMA TB-1200. Spacer must be black, roll-formed, steel-reinforced butyl rubber, 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.

The inner light must be ASTM C1172, clear annealed flat glass Type I, Class I, Quality q3

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.

## 2.4 MIRROR ACCESSORIES

### 2.4.1 Mastic

Mastic for setting mirrors must be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Provide mastic compatible with mirror backing paint, and as approved by mirror manufacturer.

### 2.4.2 Mirror Frames

Provide mirrors 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 must be 1-1/4 by 1/4 by 1/4 inch continuous at top and bottom of mirrors. Concealed fasteners of type to suit wall construction material must be provided with mirror frames.

### 2.4.3 Mirror Clips

Provide clips with concealed fasteners of type to suit wall construction material.

# 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 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.

3.5 Glazing Schedule

3.5.1 Monolithic-Glass

a. Glass Type G1: Clear float glass fully tempered float glass.

(1) Thickness: 1/4 inch.

(2) Provide safety glazing labeling.

3.5.2 Insulating-Laminated-Glass Types

a. Glass Type G2: Clear insulating laminated glass, safety application.

(1) Overall Unit Thickness: 1 inch.

(2) Thickness of OUtdoor Lite: 1/4 inch.

(3) Outdoor Lite: Clear float glass, fully tempered.

(4) Interspace Content: 1/2 inch air.

(5) Indoor Lite: Clear laminated glass with two plies of heat strengthened float glass.

a) Thickness of Each Glass Ply: 1/8 inch

b) Interlayer Thickness: 0.03 inch PVB with 3500 psi tensile strength.

(6) Provide safety glazing labeling.

b. Glass Type G3: Low-e-coated, tinted insulating laminated spandrel glass.

(1) Overall Unit Thickness: 1 inch.

(2) Thickness of Outdoor Lite: 1/4 inch.

(3) Outdoor Lite: Tinted float glass annealed.

(4) Interspae Content: 1/2 inch air.

(5) Indoor Lite: Clear laminated glass with two plies of heat strengthened float glass.

a) Thickness of Each Glass Ply: 1/8 inch.

b) Interlayer Thickness: 0.03 inch PVB with 3500 psi tensile strength.

(6) Low-E Coating: Second surface. Bronze to match B-21 CONVERT PRIDE HANGAR project.

(7) Neutral colored opacifier on the third surface.

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METAL WALL LOUVERS

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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 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 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" 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

Wall Louvers; G-AE

SD-03 Product Data

Metal Wall Louvers; G-AE

SD-04 Samples

Wall Louver Samples; G-AE

1.3 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.

1.4 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

1.5 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 Galvanized Steel Sheet

ASTM A653/A653M, coating designation G90.

2.1.2 Aluminum Sheet

ASTM B209, alloy 3003 or 5005 with temper as required for forming.

2.1.3 Extruded Aluminum

ASTM B221, alloy 6063-T5 or -T52.

2.1.4 Cold Rolled Steel Sheet

ASTM A1008/A1008M, Class 1, with matte finish. Use for interior louvers only.

2.2 METAL WALL LOUVERS

Wind driven rain 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 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions for all louvers more than 5 feet in width at not more than 5 feet on centers. Provide mullion covers on both faces of joints between louvers.

2.2.3 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 and zinc-coated or stainless steel screws and fasteners for steel 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. Color must be as indicated on drawings. Louvers 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, 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 --

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SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD
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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.

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 |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| 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

Metal Support Systems; G-AE

Submit for the erection of metal framing, and ceiling suspension systems. Indicate materials, sizes, thicknesses, and fastenings.

SD-03 Product Data

Metal Support Systems; G-AE

Recycled Content for Metal Support Systems

1.3 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 support systems and attachments per UFC 3-301-01, "Structural Engineering" in seismic zones.

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 listed in UL Fire Resistance may be provided in lieu of steel studs for erection of gypsum wallboard around structural steel columns.

2.1.1.4 Z-Furring Channels with Wall Insulation

Not lighter than 26 gage galvanized steel, Z-shaped, with 1-1/4 inch and 3/4 inch flanges and depth as indicated onthe drawings.

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 in accordance with the UL Fire Resistance, design number(s) indicated of the fire resistance rating indicated.

3.1.1.4 Z-Furring Channels with Wall Insulation

Install Z-furring channels vertically spaced not more than 24 inches o.c. Locate Z-furring channels at interior and exterior corners in accordance with manufacturer's printed erection instructions. Fasten furring channels to masonry and concrete walls with powder-driven fasteners or hardened concrete steel nails through narrow flange of channel. Space fasteners not more than 24 inches o.c.

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.

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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; R 2022) Standard Specification for Joint Compound and Joint Tape for Finishing 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 C1396/C1396M | (2017) Standard Specification for Gypsum Board |
| ASTM C1766 | (2015; R2019) Standard Specification for Factory-Laminated Gypsum Panel Products |
| 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 |

FM GLOBAL (FM)

| | |
|---|---|
| FM APP GUIDE | (updated on-line) Approval Guide http://www.approvalguide.com/ |

GYPSUM ASSOCIATION (GA)

| | |
|---|---|
| GA 214 | (2010) Recommended Levels of Gypsum Board Finish |
| GA 216 | (2010) Application and Finishing of Gypsum Panel Products |
| GA 600 | (2009) Fire Resistance Design Manual |

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

| | |
|---|---|
| SCS | SCS Global Services (SCS) Indoor Advantage |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 2818 | (2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings |
| 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-03 Product Data

Cementitious Backer Units; G-AE

Accessories; G-AE

Submit for each type of gypsum board and for cementitious backer units.

Gypsum Board; G-AE

Recycled Content for Gypsum Board

Recycled Content for Paper Facing and Gypsum Cores

VOC Content of Joint Compound

SD-06 Test Reports

ASTM E90 Factory Test Report; G-RO

ASTM E336 Field Test Report; G-RO

SD-07 Certificates

Asbestos Free Materials; G-RO

Certify that gypsum board types, gypsum backing board types, cementitious backer units, and joint treating materials do not contain asbestos.

Indoor Air Quality for Gypsum Board

SD-08 Manufacturer's Instructions

Safety Data Sheets

SD-10 Operation and Maintenance Data

Manufacturer Maintenance Instructions

## 1.3 CERTIFICATIONS

### 1.3.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

#### 1.3.1.1 Ceiling and Wall Systems

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 program 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.

#### 1.3.1.2 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 program 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

### 1.4.1 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.

### 1.4.2 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.

### 1.4.3 Handling

Neatly stack gypsum board and cementitious backer units flat to prevent sagging or damage to the edges, ends, and surfaces.

## 1.5 QUALIFICATIONS

Furnish type of gypsum board work specialized by the installer with a minimum of 3 years of documented successful experience.

## 1.6 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.

## 1.7 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.

1.8 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 including adhesives.

2.1.1 Gypsum Board

ASTM C1396/C1396M. Gypsum board must contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 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). Provide certification or validation of indoor air quality for gypsum board.

2.1.1.1 Regular

48 inch wide, 5/8 inch thick, tapered and featured edges.

2.1.1.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered and featured edges.

2.1.1.3 Mold Resistant / Anti-Microbial Gypsum

ASTM D3273. 48 inch wide, 5/8 inch thick, tapered and featured edges.

2.1.2 Factory-Laminated Gypsum Board

ASTM C1766, regular and Type X, 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.

2.1.2.1 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.

2.1.3 Cementitious Backer Units

In accordance with the Tile Council of America (TCA) Handbook.

2.1.4 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 content of joint compound.

2.1.4.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.4.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.4.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.4.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.4.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.5 Fasteners

2.1.5.1 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.

2.1.6 Accessories

ASTM C1047. Fabricate from corrosion protected steel 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.

2.1.7 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 Gypsum Board and Framing

Verify that surfaces of gypsum board and framing to be bonded with an adhesive are free of dust, dirt, grease, and any other foreign matter. Do not proceed with work until surfaces are acceptable for application of gypsum board with adhesive.

3.1.3 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. Surfaces of gypsum board and substrate members may not be bonded together with an adhesive. 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. Install 5/8 inch gypsum ceiling board over framing at 24 inch on center. 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 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.

### 3.2.3 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 heave 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 4 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.

## 3.6 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, or GA 600 for the File 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. Provide permanent labels, stencils, or markings to identify fire rated and smoke rated partitions in the facility. Labels shall be placed not less than 10'-0" AFF in spaces with exposed structure ceilings, and shall be placed within plenum areas of spaces with suspended (ATC, GWB, etc) ceiling systems whenever possible. Co-locate ceiling markings near wall markings whenever ceiling markings are required. Permanent adhesive labels, signs, or stencils are acceptable.

Lettering shall be not less than 3 inches high, with 3/8 inch minimum stroke. Color shall clearly contrast with finished substrate. Wording shall read:

"(1 HR/MIN) FIRE BARRIER - PROTECT ALL OPENINGS."

## 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. Provide permanent labels, stencils, or markings to identify STC rated partitions and floor/ceilings assemblies in the facility. Labels shall be placed not less than 10'-0" AFF in spaces with exposed structure ceilings, and shall be placed within plenum areas of spaces with suspended (ATC, GWB, etc) ceiling systems whenever possible. Co-locate ceiling markings near wall markings whenever ceiling markings are required. Permanent adhesive labels, signs, or stencils are acceptable.

Lettering shall be not less than 3 inches high, with 3/8 inch minimum stroke. Color shall clearly contrast with finished substrate. Wording shall read:

"((Value) STC) SOUND BARRIER - SEE SSM PRIOR TO ALTERING."

## 3.8 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

## 3.9 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.

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**08/20**

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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 |
| ANSI A137.3/A108.19 | (2017) American National Standard Specifications for Gauged Porcelain Tile and Gauged Porcelain Tile Panels/Slabs |

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 | (2022) Standard Specification for Portland Cement |
| ASTM C206 | (2014) Standard Specification for Finishing Hydrated Lime |
| ASTM C207 | (2018) Standard Specification for Hydrated Lime for Masonry Purposes |
| ASTM C373 | (2018)Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products |
| ASTM C648 | (2020) Standard Test Method for Breaking Strength of Ceramic Tile |
| ASTM C847 | (2014a) Standard Specification for Metal Lath |

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 |

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 |

TILE COUNCIL OF NORTH AMERICA (TCNA)

| | |
|---|---|
| TCNA Hdbk | (2017) Handbook for Ceramic, Glass, and Stone Tile Installation |

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 |

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

Detail Drawings; G-AE

SD-03 Product Data

Porcelain Tile; G-AE

Recycled Content for Porcelain Tile

Mosaic Tile; G-AE

Transition Strips

Metal Strips

Setting-Bed

Mortar, Grout, and Adhesive

Cementitious Backer Units

SD-04 Samples

Tile; G-AE

Accessories

Transition Strips

Metal Strips

Grout; G-AE

SD-07 Certificates

Indoor Air Quality for Adhesives

Indoor Air Quality for Sealants

Water Absorption Rates

SD-08 Manufacturer's Instructions

Manufacturer's Approved Cleaning Instructions

SD-10 Operation and Maintenance Data

Porcelain Tile, Data Package 1

Mosaic Tile, Data Package 1; G-RO

Transition Strips, Data Package 1; G-RO

Metal Strips, Data Package 1; G-RO

## 1.3 CERTIFICATIONS

### 1.3.1 Indoor Air Quality Certifications

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 in this Section.

### 1.3.2 Water Absorption Rates Certification

Provide certification for each tile type indicating compliance with the following water absorption (wa) rates per ANSI A137.1 criteria as tested per ASTM C373 requirements.

a. Porcelain and Mosaic Tile (Impervious): Provide water absorption (wa) of 0.5 percent or less.

## 1.4 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.

## 1.5 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.

## 1.6 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.

## 1.7 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.

## 1.8 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. Furnish gauged porcelain tile that comply with ANSI A137.3/A108.19. Provide a minimum breaking strength of 125 lbs. for wall tile and 250 lbs. for floor tile in accordance with ASTM C648. 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. 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 ceramic tiling indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each type of ceramic tiling indicated in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

### 2.1.1 Porcelain Tile (PFT-1, PWT-1, PWT-2)

Provide through body (surface color and pattern go all the way through the tile body) rectified porcelain tile. Provide tile with a V4 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) as indicated on drawings.

Provide porcelain tiling materials that contain a minimum of 10 percent recycled content. Provide data identifying percentage of recycled content for porcelain 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.

### 2.2.4 Hydrated Lime

Conform to ASTM C206 for hydrated lime, Type S or ASTM C207, Type S.

### 2.2.5 Metal Lath

Conform to ASTM C847 for flat expanded type metal lath, and weighing a minimum 2.5 pound/square yard.

## 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. 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 Ceramic Tile Grout

TCNA Hdbk; petroleum-free and plastic-free standard cement commercial portland cement grout.

2.4.3 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Provide sealant that does not change the color or alter the appearance of the grout. Refer to Section 07 92 00 JOINT SEALANTS.

Provide sealants 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. For products located on the interior of the building (inside of the weatherproofing system), provide certification or validation of indoor air quality for sealants.

2.5 SUBSTRATES

Refer to Section 09 29 00 GYPSUM BOARD for cementitious backer.

2.5.1 Cementitious Backer Units

Provide cementitious backer unit, for use as tile substrate as indicated, in accordance with TCNA Hdbk. Furnish 5/8 inch thick cementitious backer units.

2.6 MISCELLANEOUS TRIMS

2.6.1 Transition Strips

Provide stainless steel transitions between tile and resilient flooring. Provide transition strips that comply with 36 CFR 1191requirements.

2.6.2 Metal Strips (TS-1, TS-2)

Provide Cove, Angle, and L-shape trim shapes, height to match tile and setting thickness, designed specifically for flooring, and wall applications. Provide stainless steel cove strip where floor tile abuts wall tile for sanitary transition and elimination of cove tile base. Provide extruded square, stainless steel edging at tile surfaces with exposed outside edges.

2.7 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture as indicated on drawings; 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 | FLOORS |
|---|---|---|
| Dry-Set Mortar | 1/8 inch in 8 ft. | 1/8 inch in 10 ft. |
| Organic Adhesives | 1/8 inch in 8 ft. | 1/16 inch in 3 ft. |
| Latex-Portland Cement Mortar | 1/8 inch in 8 ft. | 1/8 inch in 10 ft. |
| Epoxy | 1/8 inch in 8 ft. | 1/8 inch in 10 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 and floor plans. 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 1/3 offset pattern. Begin lowest course with half offset from floor tile joints. Install in accordance with the TCNA Hdbk, method W244C-15 and with grout joints as recommended by the manufacturer for the type of tile. Install thinner wall tile flush with thicker wall tile applied on same wall and provide installation materials as recommended by the tile and setting materials manufacturer's to achieve flush installation.

### 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 FLOOR TILE

Install floor tile in straight grid pattern in accordance with TCNA Hdbk and with grout joints as recommended by the manufacturer for the type of tile. Install shower receptors in accordance with TCNA Hdbk B414.

### 3.4.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to TCNA Hdbk for workable mortar bed materials and installation. Conform to TCNA Hdbk for cured mortar bed materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniformed width.

### 3.4.2 Latex-Portland Cement

Use latex-portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCNA Hdbk. Use latex-portland cement when installing porcelain ceramic tile.

## 3.5 INSTALLATION OF MISCELLANEOUS TRIMS

### 3.5.1 Transition Strips

Install transition strips where indicated, in a manner similar to that of the ceramic tile floor and as recommended by the manufacturer. Provide thresholds full width of the opening. Install head joints at ends not exceeding 1/4 inch in width and grouted full.

### 3.5.2 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.

## 3.6 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

### 3.6.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

### 3.6.2 Floors

Provide expansion joints over construction joints, control joints, and

expansion joints in concrete slabs. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.

## 3.7 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. Submit copy of manufacturer's printed maintenance instructions.

-- End of Section --

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SECTION 09 51 00

ACOUSTICAL CEILINGS

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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 A580/A580M | (2018) Standard Specification for Stainless Steel Wire |
| 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 C834 | (2017) Standard Specification for Latex Sealants |
| ASTM E413 | (2022) Classification for Rating Sound Insulation |

| | |
|---|---|
| ASTM E580/E580M | (2022) 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 E1264 | (2022) Standard Classification for Acoustical Ceiling Products |
| ASTM E1414/E1414M | (2021a) Standard Test Method for 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 |

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 |

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 |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-301-01 | (2019, with Change 1, 2022) Structural Engineering |

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

Approved Detail Drawings; G-AE

SD-03 Product Data

Recycled Content for Type XII Ceiling Tiles

Recycled Content for Suspension Systems

SD-04 Samples

Acoustical Units

Acoustical Ceiling Tiles; G-AE

SD-07 Certificates

Indoor Air Quality for Type XII Ceiling Tiles

Indoor Air Quality for Sealants

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

1.3.1.1 Ceiling Tiles

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.

1.3.1.2 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 in this Section.

1.4 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.

1.5 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.

1.6 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.

1.7 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 one year from date of final acceptance of the work.

1.8 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 SYSTEM 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. 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. 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.

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

2.2.1.1 Type

XII (fiberglass base with membrane-faced overlay). Provide Type XII Acoustical Ceiling Tiles containing a minimum of 55 percent recycled content. Provide data identifying percentage of recycled content for Type XII ceiling tiles. Provide certification of indoor air quality for Type XII Ceiling Tiles.

2.2.1.2 Flame Spread

Class A, 25 or less

2.2.1.3 Pattern

As indicated on drawings.

2.2.1.4 Minimum NRC

0.9 when tested on mounting Type E-400 of ASTM E795.

2.2.1.5 Minimum Light Reflectance Coefficient

0.88 or greater

2.2.1.6 Nominal Size

24 by 24 inch

2.2.1.7 Edge Detail

Tegular

2.2.1.8 Finish

Factory-applied standard finish.

2.2.1.9 Minimum CAC

35

2.3 SUSPENSION SYSTEM

Provide standard exposed-grid suspension system conforming to ASTM C635/C635M for heavy-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 inside and outside corner caps and mitered 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.

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, 0.11 inch in diameter. ASTM A580/A580M, composition 302 or 304, condition annealed stainless steel, 0.11 inch 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.

### 2.4.5 Anchorage Devices

Comply with ASTM C636/C636M for anchorage devices for eyebolts and machine screws. Where aluminum is in contact with concrete, coat aluminum with bituminous paint or where exposed, with a chromatic primer and 2-coats of enamel paint.

## 2.5 ADHESIVE

Use adhesive as recommended by tile manufacturer.

## 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 on Finish Material Legend, sheet I-601; colors listed are not intended to limit the selection of equal colors from other manufacturers.

## 2.8 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C834, nonstaining. Provide sealants used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 or VOC content requirements of SCAQMD Rule 1168. Provide certification of indoor air quality for Sealants.

## 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 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

3.1.5 Adhesive Application

Wipe back of tile to remove accumulated dust. Daub acoustical units on back side with four equal daubs of adhesive. Apply daubs near corners of tiles. Ensure that contact area of each daub is at least 2 inch diameter in final position. Press units into place, aligning joints and abutting units tight and uniform without differences in joint widths.

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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**01/18**

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SECTION 09 54 23

LINEAR METAL CEILINGS
**01/18**

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 A641/A641M | (2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire |
| ASTM C635 | (2007) 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 E1264 | (2022) Standard Classification for Acoustical Ceiling Products |
| ASTM E84 | (2020) Standard Test Method for Surface Burning Characteristics of Building Materials |

CEILINGS & INTERIOR SYSTEMS CONSTRUCTION ASSOCIATION (CISCA)

| | |
|---|---|
| CISCA | (1999) Ceiling Systems Handbook |

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

| | |
|---|---|
| NAAMM | (2006) Metal Finishes Manual for Architectural and Metal Products |

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are 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-02 Shop Drawings

Linear Metal Ceiling Panels; G-AE
Metal Suspension Systems; G-AE
Aluminum Panels And Suspension System For Linear Metal Ceiling; G-AE
Installation; G-AE

SD-03 Product Data

Linear Metal Ceiling Panels
Metal Suspension Systems
Aluminum Panels And Suspension System For Linear Metal Ceiling

SD-04 Samples

Linear Metal Ceiling Panels; G-RO
Metal Suspension Systems; G-RO
Aluminum Panels And Suspension System For Linear Metal Ceiling
Finishes; G-RO

SD-10 Operation and Maintenance Data

Finishes; G-RO
Extra Materials; G-RO

## 1.3 EXTRA MATERIALS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

### 1.3.1 Linear Metal Ceiling Components

Quantity of each panel, carrier, accessory, and exposed molding and trim equal to 2 percent of quantity installed.

## 1.4 QUALITY ASSURANCE

### 1.4.1 Source Limitations

Obtain each set of linear metal pans and suspension systems from one source with resources to provide products of consistent quality in appearance, physical properties, and performance.

### 1.4.2 Surface-Burning Characteristics

Complying with ASTM E1264 for Class A materials, as determined by testing identical products according to ASTM E84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

### 1.4.3 Mockups

Build mockups to verify selections made under submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

a. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

### 1.4.4 Preinstallation Conference

Conduct conference at project site.

## 1.5 DELIVERY, STORAGE, AND HANDLING

Deliver linear metal panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

Handle linear metal panels, suspension system components, and accessories carefully to avoid damaging units and finishes in any way.

## 1.6 PROJECT CONDITIONS

### 1.6.1 Environmental Limitations

Do not install linear metal ceilings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## 1.7 COORDINATION

Coordinate layout and installation of linear metal panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, and fire-suppression system.

# PART 2 PRODUCTS

## 2.1 SYSTEM DESCRIPTION

Section includes strip linear metal pans and suspension systems for ceilings.

### 2.1.1 Performance Data

For installed products indicated to comply with design loads and other criteria, include structural analysis and other analytical data signed and sealed by the qualified professional engineer responsible for their preparation.

## 2.2 LINEAR METAL CEILING PANELS

### 2.2.1 Acoustical Metal Panel Standard

Provide manufacturer's standard linear metal panels of configuration indicated that comply with ASTM E1264 classifications as designated by types, acoustical ratings, and light reflectances unless otherwise indicated.

### 2.2.2 Sheet Metal Characteristics

For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.

a. Aluminum Sheet: Commercial-quality, .027 inch monimal roll formed

smooth surfaced.

(1) Finish: Aviation White, Powdercoat.

2.2.3 Panel Fabrication

Manufacturer's standard units of size, profile, and edge treatment indicated, formed from metal indicated to snap on and be securely retained on carriers without separate fasteners, and finished to comply with requirements indicated.

2.2.4 Panel Splices

Construction same as pans, formed for snap fit in butt cut pan ends, with manufacturer's standard finish.

2.2.5 End Cap

Metal matching panels; fabricated to fit and conceal exposed ends of panels.

2.2.6 Filler Strips

Metal matching panels; fabricated to uninterruptedly close voids between panels.

2.2.7 Moldings and Trim

Provide manufacturer's standard moldings and trim for exposed members, and as indicated or required, for edges and penetrations of ceiling, around fixtures, at changes in ceiling height, and for other conditions; of same metal and finish as linear metal ceiling panels.

2.3 METAL SUSPENSION SYSTEMS

2.3.1 Metal Suspension Systems Standard

Provide ceiling manufacturer's standard metal suspension systems of types and finishes indicated that comply with applicable ASTM C635 requirements.

2.3.2 Suspension Systems

Provide systems complete with carriers, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, fixture adapters, and other suspension components required to support ceiling units and other ceiling-supported construction.

2.3.3 Attachment Devices

Size for five times the design load indicated in ASTM C635, Table 1, Direct Hung, unless otherwise indicated.

2.3.4 Wire Hangers, Braces, and Ties

Provide wire complying with the following requirements:

a. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.

b. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635, Table 1, Direct Hung will be less than yield stress of wire, but provide not less than 12 gauge diameter wire, prestretched.

2.3.5 Carriers

Manufacturer's standard factory finished.

a. Main Carriers: Aluminum, not less than .040 inch nominal thickness, with factory-applied Aviation White paint finish.

b. Expansion Carriers: Manufacturer's standard carriers allowing for irregularities or other unusual space conditions.

2.3.6 Carrier Splices

Same metal, profile, and finish as indicated for carriers.

2.3.7 Stabilizer Channels, Tees, and Bars

Manufacturer's standard components for stabilizing main carriers at regular intervals and at light fixtures, air-distribution equipment, access doors, and other equipment; spaced as standard with manufacturer for use indicated; and factory finished with Aviation White finish.

2.3.8 Edge Moldings and Trim

Provide exposed members as indicated or required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of penetrations through ceiling, to conceal ends of panels and carriers, for fixture trim and adapters, and for other conditions; of metal and finish matching linear metal panels.

a. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

2.4 ALUMINUM PANELS AND SUSPENSION SYSTEM FOR LINEAR METAL CEILING (LMC-1)

Subject to compliance with requirements, provide product indicated on Drawings or a comparable product approved by the Contracting Officer.

2.4.1 Classification

Units complying with ASTM C635 and ASTM C636/C636M.

2.4.2 Pan Thickness

Not less than .027 inch.

2.4.3 Pan Edge Detail

Beveled.

2.4.4 Linear Module Width and Pan Face Width

11.8 inches.

2.4.5 Pan Depth

3/4 inch deep.

2.4.6 Pan Face Finish

Polished aluminum anodized.

2.4.7 Texture

Smooth.

2.4.8 End Cap, Finish of Exposed Portions

To match panel.

2.4.9 Suspension-System Main-Carrier Material

Electrolytic zinc-coated steel.

2.5 FINISHES

Comply with NAAMM for recommendations for applying and designating finishes. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping. Submit maintenance data for finishes to include in maintenance manuals.

2.5.1 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.

2.5.2 Aluminum Sheet Finishes

2.5.2.1 Powdercoat Finish

Finish process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.

PART 3 EXECUTION

3.1 EXAMINATION

Examine substrates, areas, and conditions, including structural framing and substrates to which linear metal ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of linear metal ceilings. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

Measure each ceiling area and establish layout of linear metal panels to

balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width or -length pans at borders, and comply with layout shown on reflected ceiling plans and Coordination Drawings.

3.3 INSTALLATION

Comply with ASTM C636/C636M and seismic requirement indicated, per manufacturer's written instructions and CISCA.

3.3.1 Ceiling Hangers

Suspend ceiling hangers from building's structural members and as follows:

a. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

b. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

c. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.

d. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate to which hangers are attached and for type of hanger involved.

e. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

f. Do not attach hangers to steel deck tabs.

g. Do not attach hangers to steel roof deck. Attach hangers to structural members.

h. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

i. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

3.3.2 Trim

Install trim of type indicated at perimeter of linear metal ceiling area and where necessary to conceal edges and ends of linear metal panels. Provide 6 inch wall clearance on all ceiling sides.

a. Do not use exposed fasteners, including pop rivets, on moldings and trim.

3.3.3 Suspension System Carriers

Install suspension system carriers so they are aligned and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

3.3.4 Cut

Cut linear metal panels for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

3.3.5 Coordination

Install linear metal panels in coordination with suspension system and exposed trim.

a. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.

b. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.

c. Install panels with butt joints using internal pan splices and in the following joint configuration:

(1) Aligned.

d. Where metal pan ends are visible, install end caps.

3.3.6 Hold-down Clips

Install hold-down clips where indicated.

3.4 FIELD QUALITY CONTROL

3.4.1 Special Inspections

Contracting Officer will engage a qualified special inspector to perform the following special inspections:

a. Suspended ceiling system.

b. Hangers, anchors, and fasteners.

3.4.2 Testing Agency

Contracting Officer will engage a qualified testing agency to perform tests and inspections. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections. Prepare test and inspection reports.

3.5 CLEANING

Clean exposed surfaces of linear metal ceilings, including trim after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective

covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

-- 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 E648 | (2019a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source |
| ASTM F710 | (2021) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring |
| ASTM F1482 | (2021) Standard Practice for Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring |
| ASTM F1700 | (2020) Standard Specification for Solid Vinyl Floor Tile |
| ASTM F1861 | (2021) 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 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 |

GREEN SEAL (GS)

| | |
|---|---|
| GS-36 | (2013) Adhesives for Commercial Use |

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 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-02 Shop Drawings

Resilient Flooring and Accessories; G-AE

SD-03 Product Data

Resilient Flooring and Accessories; G-AE

Adhesives

Luxury Vinyl Tile; G-AE

Recycled content for Luxury Vinyl Tile

Wall Base; G-AE

SD-04 Samples

Resilient Flooring and Accessories; G-AE

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests

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Indoor Air Quality for Luxury Vinyl Tile

Indoor Air Quality for Wall Base

Indoor Air Quality for Adhesives

SD-08 Manufacturer's Instructions

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SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories

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 Luxury Vinyl Tile and wall base products certified to meet indoor air quality requirements by FLOORSCORE, 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 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 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 LUXURY VINYL TILE (LVT-1)

Conform to ASTM F1700 Class III printed film with a minimum wear layer thickness 0.020 inch (20 mil) and minimum overall thickness of 0.200 inch with non slip/skid backing B (embossed) 9 inch by 59 inch plank 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.

2.2 WALL BASE (RB-1)

Conform to ASTM F1861, Type TP (thermoplastic) 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.

Provide certification of indoor air quality for Wall Base.

2.3 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.

2.4 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.

2.5 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D4078 for polish.

2.6 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.7 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. Provide floor patterns as specified on the drawings. 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.

2.8 FIRE RESISTANCE TESTING REQUIREMENTS

Provide a minimum average critical radiant flux of 0.45 watts per square centimeter for flooring in corridors and exits when tested in accordance with ASTM E648.

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 in a stagger pattern using full spread adhesive. 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 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.

## 3.7 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.

## 3.8 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.

## 3.9 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 --

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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 A990/A990M | (2021) Standard Specification for Castings, Iron-Nickel-Chromium and Nickel Alloys, Specially Controlled for Pressure-Retaining Parts for Corrosive Service |
| ASTM C881/C881M | (2020a) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete |
| ASTM D445 | (2019a) Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity) |
| ASTM D523 | (2014; R 2018) Standard Test Method for Specular Gloss |
| 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 D1475 | (2013) Standard Test Method for Density of Liquid Coatings, Inks, and Related Products |
| ASTM D1544 | (2004; R 2010) Standard Test Method for Color of Transparent Liquids (Gardner Color Scale) |
| ASTM D1652 | (2011; E 2012) Standard Test Method for Epoxy Content of Epoxy Resins |
| ASTM D2240 | (2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness |

| | |
|---|---|
| ASTM D2471 | (1999) Standard Test Method for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins |
| ASTM D4259 | (2018) Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application |

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. Epoxy-Resin Binder/Matrix

b. Cured Epoxy Binder

c. 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. Epoxy-Resin Binder/Matrix

b. Cured Epoxy Binder

c. 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 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-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Manufacturer's Catalog Data

SD-04 Samples

Hardboard Mounted Flooring; G-AE

Mockups; G

SD-05 Design Data

Design Mix Data

SD-07 Certificates

Listing of Product Installations

Referenced Standards Certificates

SD-11 Closeout Submittals

Warranty

## 1.4 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.

## 1.5 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. Epoxy-Resin Binder/Matrix

b. Cured Epoxy Binder

c. Surface Sealing Coat

### 1.5.1 Mockups

Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Apply full-thickness mockups on 96 inch square floor area selected by Contracting Officer. Simulate finished lighting conditions for the review of mockups.

### 1.5.2 Qualifications

Submit a listing of product installations for Epoxy-resin binder sealed concrete 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.

1.5.3 Sampling

Submit hardboard mounted 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.

1.6 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.

2.2 MATERIALS

2.2.1 Mixes

2.2.1.1 Epoxy-Resin Binder/Matrix

Provide a clear two-component compatible system epoxy resin binder consisting of: (1) a liquid blend of a biphenyl-based epoxy resin and an aliphatic polyglyceride ether, and (2) a liquid blend of two modified amine curing agents, which individually cures the epoxy resin at room temperature to a glossy smooth film. Ensure the two components and the cured epoxy binder have the following physical properties:

| PROPERTY | TEST METHOD | REQUIREMENT |
|---|---|---|
| | COMPONENT A (EPOXY RESIN) | |
| Viscosity (kinematic), at 77 degrees F, centipoises | ASTM D445 | 3000 to 5000 |
| Weight per epoxide, grams | ASTM D1652 | 205 to 225 |
| Color (Gardner Color Scale), maximum | ASTM D1544 | 5 |
| Weight per gallon, pounds | ASTM D1475 | 9.46 - 9.56 |
| | COMPONENT B (CURING AGENT) | |
| Viscosity (kinematic), at 77 degrees F, centistokes | ASTM D445 | 75 to 125 |
| Weight per gallon, pounds | ASTM D1475 | 7.50 to 7.60 |

| PROPERTY | TEST METHOD | REQUIREMENT |
|---|---|---|
| Color (Gardner Color Scale), maximum | ASTM D1544 | 8 |

2.2.1.2 Cured Epoxy Binder

Provide a cured epoxy binder with the following properties.

| PROPERTY | TEST METHOD | REQUIREMENT |
|---|---|---|
| Tensile strength, psi* at test temperature: 77 degrees F | ASTM D638 | 4500 to 6500 |
| Tensile elongation, percent* at test temperature: 77 degrees F | ASTM D638 | 20 to 40 |
| Water absorption, percent 24 hours at 77 degrees F, maximum | ASTM D570 | 0.40 |
| Hardness, Shore D | ASTM D2240 | 74 to 82 |
| Linear shrinkage, inch/inch maximum | ASTM C881/C881M | 0.006 |
| Shrinkage, glass bow, inch divergence, maximum | ASTM A990/A990M | 0.016 |
| Coefficient of linear thermal expansion, inch/inch/degree C, maximum | ASTM D696 0 degrees C to 40 degrees C | 200 X 10-6 |
| Gel time/peak exotherm at 77 degrees F, 100 gm mass in 4 ounce metal container | ASTM D2471 | 20 to 40 minutes at 300 degrees F, maximum |
| *1/8 inch thick castings | | |
| **1/8 by 1 by 3 inch castings, aged in forced draft oven | | |

2.2.1.3 Surface Sealing Coat

Provide nonambering aliphatic or aromatic moisture-curing polyurethane surface sealer into which has been incorporated a flatting agent. Add flatting agent not more than 24 hours prior to actual application of the coating. Ensure cured coating with flatting agent yields 60-degree specular gloss of 10 to 20 when tested in accordance with ASTM D523.

## 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.

#### 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 Existing Concrete Floors

Clean existing concrete floors, with hard troweled or contaminated areas in conformance with ASTM D4259. Ensure the concrete is free of all paint, sealers, curing agents, oil, grease, moisture, dirt or any other contaminants. Remove any loose or corroded segments of existing concrete. Patch with a grouting compound as recommended by the resinous flooring manufacturer. Fill all cracks with an elastomeric jointing compound compatible with the resinous flooring system used.

## 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 epoxy 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 epoxy binder 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.

## 3.3 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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FUEL RESISTIVE RESINOUS FLOORING, 5-COAT SYSTEM

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FUEL RESISTIVE RESINOUS FLOORING, 5-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; R 2022) Standard Test Method for 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) |
| ASTM E11 | (2022) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves |

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

| | |
|---|---|
| ICRI 310.2R | (2013) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair |

MASTER PAINTERS INSTITUTE (MPI)

| | |
|---|---|
| MPI 208 | (2020) Floor Coating, Thick Film, Primer, for Aircraft Maintenance Facilities |

| | |
|---|---|
| MPI 209 | (2020) Floor Coating, Thick Film, Epoxy Mortar, For Aircraft Maintenance Facilities |
| MPI 210 | (2020) Floor Coating, Thick Film, Grout Coat, 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, Surfacings, 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-AE

Epoxy Mortar Flooring System; G-AE

White Aluminum Oxide Non-Skid Grit; G-AE

SD-05, Design Data

Environmental Control System

SD-06 Test Reports

Joint Sealant Test Report

Primer Coat

Epoxy Mortar Coat

Grout Coat

Urethane Topcoat

White Aluminum Oxide Non-Skid Grit

Patch Test Demonstration

Daily Inspection Report

Adhesion Testing

SD-07 Certificates

Coating Work Plan; G-RO

Qualifications of Coating Contractors; G-RO

Joint Sealant Certificates; G-RO

Epoxy Mortar Flooring System Certificates; G-RO

Qualifications of Certified Industrial Hygienist (CIH)

Qualifications of Certified Protective Coatings Specialist (PCS)

Qualifications of Coating Inspection Company

Qualifications of QC Specialist Coating Inspector

Warranty

SD-08 Manufacturer's Instructions

Joint Sealant Manufacturer's Instructions

Epoxy Mortar Flooring System Manufacturer's Instructions

Water-Based Alkaline Degreaser

SD-11 Closeout Submittals

Inspection Logbook

## 1.3 QUALITY ASSURANCE

### 1.3.1 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.

1.3.2 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 determining the existing surface profile under paint, and procedures for ensuring that the profile is not increased beyond the maximum profile specified herein.

f. 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.

g. 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.

1.3.3 Design Data

1.3.3.1 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.

1.3.4 Test Reports

1.3.4.1 Joint Sealant Test Report

Submit test results that confirm sealant complies with Table Ia requirements. Samples must have been tested within the last three years.

1.3.4.2 Daily Inspection Report

Submit one copy of the daily inspection report to the Contracting Officer within 24 hours of the date recorded.

1.3.5 Certificates

1.3.5.1 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.

1.3.5.2 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 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.

1.3.5.3 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 approved coating inspection company must remain and not be 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.

1.3.5.4 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.

1.3.5.5 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, installation Contractor must be certified by the material manufacturer(s) to install the submitted coatings and sealant. Submit copy of certificates.

1.3.5.6 Joint Sealant Certificates

Submit literature documenting the sealant's past performance in automotive or aircraft maintenance shops. Minimum requirements are two or more maintenance shops with joint work totaling 10,000 linear feet whereby the sealant has performed for two years with less than one percent combined sealant failures and defects. Include from sealant manufacturer a list of shop locations, total linear feet of sealant applied per shop, shop point of contact, date sealant was applied, and the name of the installed sealant material.

1.3.5.7 Epoxy Mortar Flooring System Certificates

Provide manufacturer's certification of conformance to Contract requirements.

Submit literature documenting the coating system's past performance in aircraft maintenance shops and over floors with high Moisture Vapor Emission (MVE) rates. 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 4.5 pounds moisture per 24 hours, 1000 square feet. Include from flooring manufacturer a list of shop locations, 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.

1.3.6 Product Data

1.3.6.1 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.

1.3.6.2 Epoxy Mortar 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 flooring system maintenance cleaning. 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.

1.3.6.3 Water-Based Alkaline Degreaser

Submit manufacturer's printed instructions to include detailed mixing, dilution rate, application procedures, and rinsing procedures. In accordance with 29 CFR 1926.59, include SDSs for the water-based alkaline degreaser to be used at the job site.

1.4 DELIVERY, STORAGE, AND HANDLING

Store coatings and sealant in spaces with temperatures from 40 to 75 degrees F. Inspect materials on site for damage prior to use. Return to manufacturer any packaged materials in dented, rusty, or leaking containers. Return to manufacturer materials with an expired shelf life for testing, and if compliant, reissuing of shelf life extension.

1.5 COATING HAZARDS

Ensure that employees are trained in all safety plan aspects. 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.

1.6 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.

## 1.7 PATCH TEST DEMONSTRATION

Prior to the submitted flooring system's approval, apply the complete flooring system to a10 foot by 10 foot square concrete section as prepared in accordance with PART 3 EXECUTION. Within this area, perform three adhesion tests using procedures as detailed 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 topcoat and the coatings below the grout coat, submit a new coating system manufactured by a different coating vendor. Apply new coating system to a patch and subject this 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. Immediately following "passing" adhesion results, remove urethane topcoats and grout coat by sanding, repair patch test holes using epoxy mortar, and place a "Key-In Termination" adjacent to patch test perimeter. Perform coarse scarification or pneumatic scabbling as required to remove patch tests failing to meet adhesion requirements.

## 1.8 WARRANTY

Warranty materials and workmanship for a minimum of one year following completion of flooring and sealant application. The following terms and conditions form a part of the warranty: If the applied coating system develops 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 MVE rate greater than 5.0 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, adhesion testing must produce cohesive failures within the concrete, concrete removal over 95 percent of each pull-off coupon, or adhesion no less than 400 psi. Each area failing to meet adhesion requirements requires two additional adhesion tests to confirm results. 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 that has chemically attacked surfaces or lifting from joint walls. Topcoat cracking over sealant is excluded from warranty.

# PART 2 PRODUCTS

## 2.1 JOINT SEALANT

Formulate the joint sealant to exhibit the properties as listed in Table Ia.

## 2.2 EPOXY MORTAR FLOORING SYSTEM

A five-coat flooring system consisting of primer, epoxy mortar, grout

coat, and two urethane topcoats. Apply the system at a nominal thickness of 1/4 inch and contain an aluminum oxide non-skid grit broadcast. Additional requirements for primer coat, epoxy mortar, grout coat, and urethane top coat are contained in the following sub-paragraphs.

2.2.1 Primer Coat

In addition to the epoxy mortar flooring system requirements, use MPI 208 primer coat.

2.2.2 Epoxy Mortar Coat

In addition to the epoxy mortar flooring system requirements, use MPI 209 epoxy mortar coat compatible with MPI 208, MPI 210, and MPI 212.

2.2.3 Grout Coat

In addition to the epoxy mortar flooring system requirements, use MPI 210 grout coat compatible with MPI 208, MPI 209, and MPI 212.

2.2.4 Urethane Topcoat

In addition to the epoxy mortar flooring system requirements, use MPI 212 topcoat compatible with MPI 208, MPI 209, and MPI 210.

2.3 WHITE ALUMINUM OXIDE NON-SKID GRIT

Size No. 60, dust-free (washed and dry), minimum 99 percent pure, having the following sieve analysis when tested using a 2.2 pound sample (ASTM E11 ):

| | |
|---|---|
| Sieve No. 40 | 100 percent passing |
| Sieve No. 50 | 15-30 percent retained |
| Sieve No. 60 | 70-85 percent retained |
| Sieve No. 70 | 0-15 percent retained |

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 (e.g., primer, intermediate, grout coat, 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. Label samples by designated name, specification number, batch number, project Contract number, sample date, intended use, and quantity involved. When the applied epoxy mortar system has met the requirements defined in the paragraph ADHESION TESTING, return coating samples to the installation contractor for proper disposal.

3.2 JOINT MATERIAL REMOVAL, RE-SAW CUTTING, CRACK CHASING

Remove 100 percent of the existing material in all joints including

material bonded to joint walls and base. Rigid material may require saw cutting equipment to remove. Joints may be widened up to 1/8 inch when re-saw cutting. Hairline cracks having no more than 1/8 inch width are typically not repaired. Cracks greater than 1/8 inch width can be chased to a minimum depth of 1/2 inch and sealed using the procedures and materials specified for joints. Cracks more than 3/4 inch width can be repaired using either epoxy mortar or epoxy concrete. Chase concrete cracks identified for repair and open to a minimum depth of 1/2 inch below crack surface resulting in crack(s) with smooth vertical walls.

## 3.3 DEGREASING

On both previously coated and uncoated concrete, degrease entire floor by scrubbing using a hot potable water solution, 120 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 must be complete when the rinse water appears clear. If the industrial detergent is not biodegradable, collect all rinse water and dispose of 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.

## 3.4 COATING SYSTEM REMOVAL

Remove 100 percent of the existing coating system employing one or more of the following techniques: shot blasting, chipping, scraping, sanding, scarification, high pressure water blasting, and various hand tools. Impact tools such as scabblers may be used to remove unsound epoxy mortar flooring systems. In general, a coating system cannot be completely removed by shot blasting and, to attain 100 percent coating removal, requires a combination of the above techniques.

## 3.5 SURFACE PREPARATION

Shot blast entire floor to produce a level of coarseness equal to ICRI 310.2R CSP 3. Overlap each shot blasting pass by 1/4 to 1/2 inch. Add new shot to shot blasting equipment prior to blasting. Prepare concrete surfaces inaccessible to shot blasting, perimeter wall bases and under secured equipment, using a diamond disk grinding or light scarification to produce a level of coarseness equal to ICRI 310.2R CSP 2, ICRI 310.2R CSP 4, respectively. Resulting surfaces must appear clean and contain the appropriate surface coarseness level. If the resulting cleanliness level cannot be determined, place numerous drops of water on surfaces that appear contaminated. If the water drops soak into concrete, the surfaces are hydrocarbon contamination free (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 coarseness level 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.

### 3.5.1 Concrete Masonry Units (CMU) Surface Preparation

Remove 100 percent of coatings 4 inches up the base of CMU walls adjacent the flooring space, and prepare surface by power grinding to a resulting level of coarseness equal to ICRI 310.2R CSP 2. If oils/grease are present, degrease in accordance with the Article DEGREASING.

## 3.6 COVE STRIP INSTALLATION

Install a continuous cove strip at a nominal height of 4 inches up each CMU perimeter wall base. Install a solvent-resistant cove strip using a solvent-resistant adhesive.

## 3.7 KEY-IN TERMINATIONS

Place the "Key-In" termination as detailed in SSPC-TU 2/NACE 6G197 Figure 8 at transition surfaces, directly below doorways, and adjacent walls, floor drains, drain grates (interior side), and all other obstructions embedded into the floor slab. The Key-In termination must contain one vertical wall at a depth from 3/8 to 5/8 inch and, leading down to the resulting vertical depth, a sloped surface from 1-1/2 to 2 inches. A hand held concrete saw can be used to cut the correct vertical depth followed by power tool grinding to create a sloped surface. Remove concrete dust by vacuuming.

## 3.8 CRACK REPAIRS

Use the "Elastomeric Underlayer Crack-Bridging Design" as detailed in SSPC-TU 2/NACE 6G197 Figure 7 over the surface of epoxy mortar filled cracks.

### 3.8.1 Install Bondbreaker

Install bondbreaker, either solvent-resistant bondbreaker tape or a 1/8 to 1/4 inch No. 20-No. 40 mesh silica sand layer, to the base of previously chased cracks identified for repair. For cracks without a rigid base, install suitably sized fiberboard to a depth of 1/2 inch below floor level and with bondbreaker over exposed fiberboard. Install bondbreaker to cover the crack's horizontal base and continuously span the entire crack length. Bondbreaker application prevents epoxy mortar from penetrating deep into cracks. Use bondbreaker tape no more than 6 mils thick. In this application, the use of backer rod is prohibited.

### 3.8.2 Repair Cracks

Using the specified materials, prime interior crack walls and apply epoxy mortar directly into wet primer. Finish epoxy mortar level with floor and without feathered edges. When cured, remove mortar imperfections by sanding flush with adjacent concrete. Apply solvent-resistant tape parallel to each side of the mortar filled crack(s) at a minimum inner width of 4 inches between tape. A 4 inch inner tape width is generally suitable for cracks less than 1/2 inch wide whereas cracks more than 1/2 inch wide can require an inner tape width of 6 inches. Apply 1/24 inch of the specified sealant, in one coat, directly over filled crack(s) and spread flush with inner tape edges: a stiff bristled paintbrush can be used to spread the sealant. Use a Wet Film Thickness (WFT) gage to confirm sealant application is between 35 to 40 mils wet. Remove tape and allow sealant to cure a minimum of 24 hours prior to the epoxy mortar flooring system application. Sealant application above 50 mils dry will

require removal and reapplication.

## 3.9 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 water drops onto surfaces and observe for beading. Test all other surfaces that show visible signs of potential contamination. Perform additional degreasing to surfaces displaying water beading in accordance with Article DEGREASING.

## 3.10 COATING APPLICATION

Prior to the flooring system application, vacuum flooring space and mark all joints.

### 3.10.1 Isolation (Expansion) and Construction Joint Treatment

Install into each isolation (expansion) and construction joint, a continuous length of round polyethylene backer rod flush with the floor's surface and under 30 percent compression.

### 3.10.2 Contraction Joint Treatment

Apply primer and epoxy mortar directly into all contraction joints. This quantity is in addition to the specified 1/4 inch epoxy mortar thickness. This step may be performed either prior to, or during, the full epoxy mortar application.

### 3.10.3 Primer Application

Apply MPI 208 epoxy primer to flooring space at a minimum of 10.0 mils wet. Do not prime previously installed patch test.

### 3.10.4 Epoxy Mortar Application

Apply MPI 209 epoxy mortar at 1/4 inch directly into wet primer using a screed box or equal equipment. Finish open areas using a power trowel with stainless steel blades. Perimeter edges and adjacent equipment footings may require finishing by stainless steel hand trowel. Directly above areas with Key-In terminations and at a distance from 1 to 1-1/2 inches away from the mortar's outer edge, slope the mortar down and flush with the concrete's surface. Terminate the resulting angle flush with the Key-In termination vertical cut. Apply epoxy mortar flush with previously installed patch test. Do not apply epoxy mortar onto patch test surface. When sufficiently cured, sand entire mortar surface. Resulting surface must appear level, contain uniform thickness, and be free of surface imperfections including trowel marks.

### 3.10.5 Primer Application to CMU Walls

When the epoxy mortar has sufficiently cured, prime approximately 4 inches up base of CMU walls to cove strip and 2 inches adjacent the wall's base using the specified primer.

### 3.10.6 Epoxy Mortar Application to CMU Walls

Apply MPI 209 epoxy mortar directly into wet primer at 3/16 to 1/4 inch. Use a cove trowel to create a rounded transition between floor surfaces

and perimeter wall bases. When sufficiently cured, sand the base and 4 inches up perimeter walls. Resulting finish must contain a rounded transition of uniform thickness between flooring surfaces and CMU walls. When sufficiently cured, sand mortar surfaces. Resulting surface must be free of surface imperfections including trowel marks.

3.10.7 Grout Coat Application

Sweep and vacuum up residual dust from epoxy mortar sanding. Apply MPI 210 grout coat to epoxy mortar at a minimum of 10 mils wet. Apply grout coat to previously install patch test. Where wall bases are used, extend coating up CMU wall. If the cured grout coat feels oily/greasy, an amine blush has occurred which requires removal. Consult the coating manufacturer to recommend an appropriate blush removal procedure. Epoxy amines can blush during cool temperatures with high humidity.

3.10.8 Grout Coat Sanding

Sand grout coat using 100 grit or finer sandpaper to a dull appearance with visible scratches. Resulting surface must appear 100 percent absent of gloss with zero shiny spots. Lightly sand perimeter edges and around equipment footings.

3.10.9 Saw Cutting and Sealing Joints

Use the "Conventional Sealed Joint" as detailed in Figure 1 of SSPC-TU 2/NACE 6G197 to seal each contraction and expansion joint. Take care to reduce contamination from saw cutting equipment and foot traffic. Limit floor access to essential Contractor personnel. When performing joint work, including saw cutting, suggest placing clean rolled cardboard adjacent joint surfaces to reduce coating system contamination.

3.10.9.1 Saw Cut Contraction Joints

Place saw cuts directly in the middle of each contraction joint 1/4 inch wide, placed to a minimum depth of 1-1/4 inches, and span the joint's entire length.

3.10.9.2 Saw Cut Isolation (Expansion) and Construction Joints

Place saw cuts to the isolation (expansion) and construction joint's original width and to a minimum depth of 1-1/4 inches. Completely remove the epoxy mortar across the joint's width and further remove the previously installed backer rod.

3.10.9.3 Install Backer Rod

Install a continuous length of round, closed-cell polyethylene backer rod into each saw cut. For 1/2, 3/8 and 1/4 inch wide saw cuts, place backer rod to a depth of 3/8 inch below the grout coat's surface the highest point on the backer rod. For expansion joint saw cuts greater than or equal to 3/4 inch wide, place backer rod to a depth of 5/8 inch below the grout coat's surface. Fit backer rod tight between joint walls under 30 percent compression and place using a backer rod tool. Remove and reinstall all backer rod that is the incorrect size or at the incorrect depth. Following backer rod installation, apply painter's tape to surfaces adjacent joints to protect from sealant.

3.10.9.4 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 to 1/24 inch below the grout coat's surface. Remove and reapply cured sealant remaining either flush or greater. Following sealant application, remove painter's tape and sealant drips on grout coat. Prior to topcoating, cure sealant a minimum of 24 hours.

3.10.10 Application of Topcoats

Apply two coats of MPI 212 urethane topcoat. Broadcast No. 60, white, aluminum oxide non-skid grit into the second urethane topcoat.

3.10.10.1 Non-Skid Grit Broadcast

Broadcast non-skid grit at a rate of 1.0 pound per 100 square feet into the second urethane topcoat 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.

3.10.10.2 Grout Coat Cleaning

Inspect floor for shiny grease spots and, if detected, spot degrease using manufacturer approved solvent(s) with clean, lint-free rags. Sweep and vacuum up all residual dirt and dust. Solvent wipe all surfaces using solvent(s) and procedures as recommended by manufacturer of epoxy mortar flooring system.

3.10.10.3 First Topcoat

Apply a full coat of 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 foot section of floor surface. Sealant is to be lightly coated.

3.10.10.4 Second Topcoat

Apply a second coat of urethane topcoat at a spreading rate from 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 foot section 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 into the second urethane topcoat and backroll in two directions. Test the adhesion of the epoxy mortar flooring system in accordance with the paragraph ADHESION TESTING.

3.10.10.5 Walkway Stripes and Grounding Rod Markings

Place the walkway stripe and grounding rod marker, if applicable, according to Government drawings. When the second topcoat is within its recoat window, apply a walkway stripe of the red/orange urethane topcoat at 3.0 mils DFT. Lightly broadcast non-skid grit into the wet walkway stripe. Use solvent-resistant tape to protect the floor coating against stripe coat bleed. A thin clear coat of either epoxy or urethane may be required to prevent stripe coat bleed prior to the full application of the colored stripe coat. Completely hide the topcoat color with the red/orange stripe, in one coat. If insufficient hiding occurs, apply one

additional walkway stripe coat. Apply grounding rod markings using similar procedures, urethane topcoat, and colors and size according to Government drawings.

## 3.11 CURING

Installed materials must cure and display performance equal to manufacturer's product literature. Remove and reapply improperly cured material.

## 3.12 FIELD QUALITY CONTROL

### 3.12.1 Coating Inspector

Consider the Coating Inspector a QC Specialist, working for the QC Manager, and be qualified in accordance with Section 01 45 00.00 10 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.

### 3.12.2 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 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 each coat application, 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 evaluation method, evaluation criteria, areas requiring rework, and all other pertinent observations.

#### 3.12.2.1 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 in Section 01 45 00.00 10 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.

#### 3.12.2.2 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 of the project and prior to final payment.

3.12.2.3 Inspection Equipment

Use equipment in good condition, operational within its design range, and calibrated as required by the specified standard for each device.

3.12.3 Adhesion Testing

Perform a minimum of three modified adhesion tests (ASTM D4541) on the topcoat no less than forty-eight hours following application. Select three random flooring locations spaced a minimum of 20 feet between each location. Vertically core completely through the epoxy mortar flooring system and a minimum of 3/8 inch into concrete using a suitable drill fitted with a 1 inch diameter core bit. Throughout coring, employ a best effort attempt to avoid fracturing and overheating both the mortar system and concrete: improper coring can affect adhesion results. Adhere directly to each cored surface's center a 3/4 inch diameter pull-off coupon. Lightly sand test area flooring surface prior to attaching pull-off coupons containing a grit-blasted anchor profile. When pull-off coupon adhesive has sufficiently cured, 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 mortar 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. Two additional tests will confirm results for each non-compliant area. Remove and rework all areas unable to meet adhesion requirements to sound material. Fill core holes using primer, sand-filled epoxy mortar, grout coat, and urethane topcoats. Finish resulting repairs flush with adjacent coatings, displaying an equivalent appearance.

3.13 FINAL CLEANUP

Following work completion, remove debris, equipment, and materials from 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

MATERIAL REQUIREMENTS

Table Ia - Sealant

| Test | Minimum Requirement (maximum where indicated) |
|---|---|
| Sealant System (two-pack: self-leveling) | Polysulfide (Manganese Cure; MnO2) 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 Sand Filled Epoxy Polyamine | 140 psi |
| Adhesion to Urethane Topcoats (paintable sealant) | 140 psi |

NOTES: (1) Immerse and test a minimum three - 2 by 1/2 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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**11/17, CHG 2: 08/20**

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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 134 | (2016) Electrostatic Propensity of Carpets |
| AATCC 165 | (2013) Colorfastness to Crocking: Textile Floor Coverings - Crockmeter Method |
| AATCC 174 | (2016) Antimicrobial Activity Assessment of New Carpets |

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 |

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 |

CARPET AND RUG INSTITUTE (CRI)

| | |
|---|---|
| CRI 104 | (2015) Carpet Installation Standard for Commercial Carpet |
| CRI 105 | (2015) Carpet Installation Standard for Residential Carpet |
| CRI GLP QM | (2017) Green Label Plus Quality Manual |
| CRI Test Method 103 | (2015) Standard Test Method for the Evaluation of Texture Appearance Retention of Carpet Standards Program |

GREEN SEAL (GS)

| | |
|---|---|
| GS-36 | (2013) Adhesives for Commercial Use |

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

| | |
|---|---|
| SCS | SCS Global Services (SCS) Indoor Advantage |

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

| | |
|---|---|
| SCAQMD Rule 1113 | (2016) Architectural Coatings |
| SCAQMD Rule 1168 | (2017) Adhesive and Sealant Applications |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 16 CFR 1630 | Standard for the Surface Flammability of Carpets and Rugs (FF 1-70) |

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

Installation Drawings; G-AE

SD-03 Product Data

Carpet; G-AE

Recycled Content for Carpeting; S

Indoor Air Quality for Non-Aerosol Adhesives; S

Indoor Air Quality for Concrete Primer; S

SD-04 Samples

Carpet; G-AE

SD-06 Test Reports

Moisture and Alkalinity Tests; G-AE

SD-07 Certificates

Indoor Air Quality for Carpet; S

SD-08 Manufacturer's Instructions

Surface Preparation

SD-10 Operation and Maintenance Data

Cleaning and Protection

SD-11 Closeout Submittals

Warranty

## 1.3 CERTIFICATIONS

### 1.3.1 Indoor Air Quality Certifications

#### 1.3.1.1 Floor Covering Materials

Provide carpet products certified to meet indoor air quality requirements by UL 2818 (GreenGuard) Gold, SCS Global Services Indoor Advantage Gold, CRI GLP QM or provide certification or validation by other third-party program 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 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.

1.5 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.

1.6 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, and 3) Carpet Cushion. 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 of CDPH SECTION 01350. Provide certification or validation of indoor air quality for carpet.

2.1.3 Physical Characteristics for Entrance Carpet

2.1.3.1 Carpet Construction

Tufted

2.1.3.2 Type

Entrance 24 by 24 inch square width.

2.1.3.3 Pile Type

Tufted

2.1.3.4 Pile Fiber

Commercial 100 percent branded (federally registered trademark) Duracolor Premium Nylon.

2.1.3.5 Gauge or Pitch

Minimum 5/32 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 38 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 0.144 inch in accordance with ASTM D6859

2.1.3.9 Pile Density

Minimum 9,500

2.1.3.10 Dye Method

Solution dyed

2.1.3.11 Backing Materials

Provide primary backing materials like EcoFlex ICT. 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 Static Control

Provide static control to permanently regulate static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 70 degrees F in accordance with AATCC 134.

2.2.3 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.

2.2.4 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.

2.2.5 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.

2.2.6 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.

2.2.7 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.

2.2.8 Delamination Strength

Provide delamination strength for tufted carpet with a secondary back of minimum 2.5 lbs/inch.

2.2.9 Antimicrobial

Nontoxic antimicrobial treatment in accordance with AATCC 174 Part I (qualitative), guaranteed by the carpet manufacturer to last the life of the carpet.

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. Non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must 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. Aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) must 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 GS-36. Provide validation of indoor air quality for non-aerosol adhesives. Concrete primer products used on the interior of the building (defined as inside of the weatherproofing system) must 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 1113. Provide validation of indoor air quality for concrete primer.

## 2.4 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

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. Use autofoam mothproofing system for wool carpets.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 Carpet.

Do not install building construction materials that show visual evidence of biological growth.

### 3.4.1 Entrance Carpet Installation

Install tiles with permanent vinyl-compatible adhesive and snug joints. Use 1/4 turn installation method.

## 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

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 to the Government. Remove non-retained scraps from site and recycle appropriately.

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. Furnish three percent extra of total adhesive tabs.

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3.14.2.3 MPI Division 5: Interior Metal, Ferrous and Non-Ferrous Paint Table
3.14.2.4 MPI Division 6: Interior Wood Paint Table
3.14.2.5 MPI Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

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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, existing coated surfaces, and existing uncoated surfaces, of the building and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.1.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the building 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 and existing 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.

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 |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C920 | (2018) Standard Specification for Elastomeric Joint Sealants |
| 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 D2824/D2824M | (2018) Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, and Fibered without Asbestos |
| ASTM D4214 | (2007; R 2015) Standard Test Method for |

| | |
|---|---|
| | Evaluating the Degree of Chalking of Exterior Paint Films |
| 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 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 |

MASTER PAINTERS INSTITUTE (MPI)

| | |
|---|---|
| MPI 1 | (2012) Aluminum Paint |
| MPI 3 | (2016) Primer, Alkali Resistant, Water Based |
| MPI 4 | (2016) Interior/Exterior Latex Block Filler |
| MPI 8 | (2016) Alkyd, Exterior Flat (MPI Gloss Level I) |
| MPI 9 | (2016) Alkyd, Exterior Gloss (MPI Gloss Level 6) |
| MPI 10 | (2016) Latex, Exterior Flat (MPI Gloss Level 1) |
| MPI 11 | (2016) Latex, Exterior Semi-Gloss, MPI Gloss Level 5 |
| MPI 17 | (2016) Primer, Bonding, Water Based |
| MPI 23 | (2015) Primer, Metal, Surface Tolerant |
| MPI 39 | (2018) Primer, Latex, for Interior Wood |
| MPI 44 | (2016) Latex, Interior, (MPI Gloss Level 2) |
| MPI 47 | (2016) Alkyd, Interior, Semi-Gloss (MPI Gloss Level 5) |
| MPI 48 | (2016) Alkyd, Interior, Gloss (MPI Gloss Level 6-7) |

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|---|---|
| MPI 49 | (2015) Alkyd, Interior, Flat (MPI Gloss Level 1) |
| MPI 50 | (2015) Primer Sealer, Latex, Interior |
| MPI 51 | (2016) Alkyd, Interior, (MPI Gloss Level 3)2 |
| MPI 52 | (2016) Latex, Interior, (MPI Gloss Level 3) |
| MPI 54 | (2016) Latex, Interior, Semi-Gloss (MPI Gloss Level 5) |
| 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 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 108 | (2015) Epoxy, High Build, Low Gloss |
| MPI 119 | (2016) Latex, Exterior, Gloss (MPI Gloss Level 6) |
| MPI 134 | (2015) Primer, Galvanized, Water Based |
| MPI 138 | (2016) Latex, Interior, High Performance Architectural, (MPI Gloss Level 2) |
| MPI 139 | (2016) Latex, Interior, High Performance Architectural, (MPI Gloss Level 3) |
| MPI 140 | (2016) Latex, Interior, High Performance Architectural, (MPI Gloss Level 4) |
| MPI 141 | (2016) Latex, Interior, High Performance Architectural, Semi-Gloss (MPI Gloss Level 5) |
| MPI 144 | (2016) Latex, Interior, Institutional Low Odor/VOC, (MPI Gloss Level 2) |
| MPI 145 | (2016) Latex, Interior, Institutional Low Odor/VOC, ( MPI Gloss Level 3) |

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|---|---|
| MPI 146 | (2016) Latex, Interior, Institutional Low Odor/VOC, (MPI Gloss Level 4) |
| 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 161 | (2016) Light Industrial Coating, Exterior, Water Based ( MPI Gloss Level 3) |
| MPI 163 | (2016) Light Industrial Coating, Exterior, Water Based, Semi-Gloss (MPI Gloss Level 5) |
| MPI 164 | (2016) Light Industrial Coating, Exterior, Water Based, Gloss (MPI Gloss Level 6) |
| 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 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 | (2015) 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 |

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| MIL-STD-101 | (2014; Rev C) Color Code for Pipelines and for Compressed Gas Cylinders |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FED-STD-313 | (2018) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.1000 | Air Contaminants |
| 29 CFR 1910.1001 | Asbestos |

## 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 | |

| Gloss Level | Description | Units at 60 degree angle | Units at 80 degree angle |
|---|---|---|---|
| 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 textiles, unprimed gypsum wallboard, 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 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:

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

Product Data Sheets

Sealant

SD-04 Samples

Color

SD-07 Certificates

Qualification Testing laboratory for coatings

Indoor Air Quality for Paints and Primers

SD-08 Manufacturer's Instructions

Application Instructions

Mixing

Manufacturer's Safety Data Sheets

SD-10 Operation and Maintenance Data

Coatings, Data Package 1

## 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 Coating Contractor's Qualification

Submit the name, address, telephone number, and e-mail address of the Contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on a minimum of three similar projects within the past three years. List information by individual and include the following:

a. Name of individual and proposed position for this work.

b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address and telephone number of facility owner

Name of individual in facility owner's organization who can be contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.6.3 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.

1.6.4 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.

1.6.5 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 Indoor Air Quality for Paints and Primers. Submit required indoor air quality certifications in one submittal package.

1.6.6 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.

1.6.6.1 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.

1.6.6.2 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.

## 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.

d. The appropriate OSHA standards in 29 CFR 1910.1001 for surface preparation of painted surfaces containing asbestos. Removal and disposal of coatings which contain asbestos materials is specified in Section 02 82 00 ASBESTOS REMEDIATION. Refer to drawings for list of hazardous materials located on this project. Coordinate paint preparation activities with this specification section.

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 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 on drawings. 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.

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 REPUTTYING AND REGLAZING

Remove cracked, loose, and defective putty or glazing compound on glazed sash and provide new putty or glazing compound. Where defective putty or glazing compound constitutes 30 percent or more of the putty at any one light, remove the glass and putty or glazing compound and reset the glass. Remove putty or glazing compound without damaging sash or glass. Clean rabbets to bare wood or metal and prime prior to reglazing. Provide linseed oil putty for wood sash. Patch surfaces to provide smooth transition between existing and new surfaces. Finish putty or glazing compound to a neat and true bead. Allow glazing compound time to cure, in accordance with manufacturer's recommendation, prior to coating application. Allow putty to set one week prior to coating application.

## 3.3 RESEALING OF EXISTING EXTERIOR JOINTS

### 3.3.1 Surface Condition

Begin with surfaces that are clean, dry to the touch, and free from frost and moisture; remove grease, oil, wax, lacquer, paint, defective backstop, or other foreign matter that would prevent or impair adhesion. Where adequate grooves have not been provided, clean out to a depth of 1/2 inch and grind to a minimum width of 1/4 inch without damage to adjoining work. Grinding is not required on metal surfaces.

### 3.3.2 Backstops

In joints more than 1/2 inch deep, install glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free of oil or other staining elements as recommended by sealant manufacturer. Provide backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

### 3.3.3 Primer and Bond Breaker

Install the type recommended by the sealant manufacturer.

### 3.3.4 Ambient Temperature

Between 38 degrees F and 95 degrees F when applying sealant.

### 3.3.5 Exterior Sealant

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. Color(s) will be selected by the Contracting Officer. Apply the sealant in accordance with the manufacturer's printed instructions. Force sealant into joints with sufficient pressure to fill the joints solidly. Apply sealant uniformly smooth and free of wrinkles.

### 3.3.6 Cleaning

Immediately remove fresh sealant from adjacent areas using a solvent recommended by the sealant manufacturer. Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean condition. Allow sealant time to cure, in accordance with manufacturer's recommendations, prior to coating.

## 3.4 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, 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.

### 3.4.1 Additional Requirements for Preparation of Surfaces With Existing Coatings

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

a. Test existing finishes for lead before sanding, scraping, or removing. If lead is present, refer to paragraph Toxic Materials.

b. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D235 or as specified in MPI MRM. Wipe the surfaces dry with a clean, dry, lint free cloth. Wipe immediately preceding the application of the first coat of any coating, unless specified otherwise.

c. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

d. The requirements specified are minimum. Comply also with the application instructions of the paint manufacturer and specific surface preparation requirements as outlined in MPI MRM Exterior Surface Preparation and Interior Surface Preparation.

e. Thoroughly clean previously painted surfaces specified to be repainted of all grease, dirt, dust or other foreign matter.

f. Remove blistering, cracking, flaking and peeling or otherwise deteriorated coatings.

g. Remove chalk so that when tested in accordance with ASTM D4214, the chalk resistance rating is no less than 8.

h. Roughen slick surfaces. Repair damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls with suitable material to match adjacent undamaged areas.

i. Feather and sand smooth edges of chipped paint.

j. Clean rusty metal surfaces in accordance with SSPC requirements. Use solvent, mechanical, or chemical cleaning methods to provide surfaces suitable for painting.

k. Provide new, proposed coatings that are compatible with existing coatings.

3.4.2 Existing Coated Surfaces with Minor Defects

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings. Remove chalking by sanding or blasting so that when tested in accordance with ASTM D4214, the chalk rating is not less than 8.

3.4.3 Removal of Existing Coatings

Remove existing coatings from the following surfaces:

a. Surfaces containing large areas of minor defects;

b. Surfaces containing more than 20 percent peeling area; and

c. Surfaces designated by the Contracting Officer, such as surfaces where rust shows through existing coatings.

3.4.4 Substrate Repair

a. Repair substrate surface damaged during coating removal;

b. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

c. Clean and prime the substrate as specified.

3.5 PREPARATION OF METAL SURFACES

3.5.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2. 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.

b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/NACE No.3 / SSPC-SP WJ-3/NACE WJ-3.

3.5.2 Final Ferrous Surface Condition:

3.5.2.1 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.

3.5.2.2 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.

3.5.2.3 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.

3.5.3 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent 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.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC-SP WJ-3/NACE WJ-3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Spot abrasive blast rusted areas as described for steel in SSPC SP 6/NACE No.3, and waterjet to SSPC-SP WJ-3/NACE WJ-3 to remove existing coating.

3.5.4 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.

3.5.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D235. Wipe dry with clean, dry cloths.

3.5.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.6 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.6.1 Concrete and Masonry

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 existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

(2) Fungus and Mold: Wash new, existing coated, and existing uncoated 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.

3.6.2 Gypsum Board, Plaster, and Stucco

3.6.2.1 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.

3.6.2.2 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.

3.6.2.3 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.

## 3.7 APPLICATION

### 3.7.1 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. Touch up damaged coatings before applying subsequent coats.

h. 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.

i. 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.

j. All fire suppression system valves must be marked with permanent tags indicating normally open or normally closed.

k. 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.

l. 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.

m. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

3.7.2 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.

3.7.3 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.

3.7.4 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 5 | Exterior Metal, Ferrous and Non-Ferrous Paint Table |

| Table for Interior Applications | |
|---|---|
| MPI Division | Substrate Application |
| MPI Division 3 | Interior Concrete Paint Table |
| MPI Division 4 | Interior Concrete Masonry Units Paint Table |

| Table for Interior Applications | |
|---|---|
| MPI Division 5 | Interior Metal, Ferrous and Non-Ferrous Paint Table |
| MPI Division 6 | Interior Wood Paint Table |
| MPI Division 9 | Interior Plaster, Gypsum Board, Textured 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.

3.8 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. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 1.5 mils DFT immediately prior to application of epoxy or urethane coatings.

e. 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.

f. 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.

## 3.9 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in MPI Division 3, 4 and 9 for Exterior and Interior.

## 3.10 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 surfaces which will be inaccessible after erection.

c. Apply stains in accordance with manufacturer's printed instructions.

## 3.11 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.

## 3.12 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.

## 3.13 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.

## 3.14 PAINT TABLES

Acceptable products are listed in the MPI Green Approved Products List, available at http://www.specifygreen.com/APL/ProductIdxByMPInum.asp.

3.14.1 Exterior Paint Tables

3.14.1.1 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 |
| MPI EXT 5.1Q-G6 (Gloss) | MPI REX 5.1D-G6 (Gloss) | MPI 23 | MPI 9 | MPI 9 | 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 | | | | | |
|---|---|---|---|---|---|
| New | Existing, uncoated | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.1D-G5 (Semigloss) | MPI REX 5.1D-G5 (Semigloss) | MPI 79 | MPI 94 | MPI 94 | 5.25 mils |
| MPI EXT 5.1D-G6 (Gloss) | MPI REX 5.1D-G6 (Gloss) | MPI 79 | MPI 9 | MPI 9 | 5.25 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

(3) Existing steel that has been spot-blasted to SSPC SP 6/NACE No.3

(a) Surface previously coated with alkyd or latex

| Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| Existing, previously coated with alkyd or latex | Primer | Intermediate | Topcoat | System DFT |
| MPI REX 5.1C-G5 (Semigloss) | MPI 79 | MPI 163 | MPI 163 | 5 mils |

| | | | | |
|---|---|---|---|---|
| MPI REX 5.1C-G6 (Gloss) | MPI 79 | MPI 164 | MPI 164 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(b) Surfaces previously coated with epoxy

| Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| Existing, previously coated with epoxy | Primer | Intermediate | Topcoat | System DFT |
| MPI REX 5.1L-G5 (Semigloss) | MPI 101 | MPI 163 | MPI 163 | 5 mils |
| MPI REX 5.1L-G6 (Gloss) | MPI 101 | MPI 164 | MPI 164 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Pigmented Polyurethane | | | | |
|---|---|---|---|---|
| Existing, previously coated with epoxy | Primer | Intermediate | Topcoat | System DFT |
| MPI REX 5.1H-G6 (Gloss) | MPI 101 | MPI 108 | MPI 72 | 8.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(4) New and existing steel blast cleaned to SSPC SP 10/NACE No. 2

| Waterborne Light Industrial | | | | | |
|---|---|---|---|---|---|
| New | Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.1R-G5 (Semigloss) | MPI EXT 5.1R-G5 (Semigloss) | MPI 101 | MPI 108 | MPI 163 | 8.5 mils |
| MPI EXT 5.1R-G6 (Gloss) | MPI EXT 5.1R-G6 (Gloss) | MPI 101 | MPI 108 | MPI 164 | 8.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

| Pigmented Polyurethane | | | | | |
|---|---|---|---|---|---|
| New | Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.1J-G6 (Gloss) | MPI EXT 5.1J-G6 (Gloss) | MPI 101 | MPI 108 | MPI 72 | 8.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

B. Exterior Galvanized Surfaces

(1) New Galvanized surfaces

| Waterborne Primer / Latex | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.3H-G1 (Flat) | MPI 134 | MPI 10 | MPI 10 | 4.5 mils |
| EXT 5.3H-G5 (Semigloss) | MPI 134 | MPI 11 | MPI 11 | 4.5 mils |
| MPI EXT 5.3H-G6 (Gloss) | MPI 134 | MPI 119 | MPI 119 | 4.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Waterborne Primer / Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.3J-G5 (Semigloss) | MPI 134 | MPI 163 | MPI 163 | 4.5 mils |
| MPI EXT 5.3J-G6 (Gloss) | MPI 134 | MPI 164 | MPI 164 | 4.5 mils |
| Topcoat: Coating to match adjacent 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 |

| | | | | |
|---|---|---|---|---|
| MPI EXT 5.3K-G6 (Gloss) | MPI 101 | MPI 164 | MPI 164 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Pigmented Polyurethane | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.3L-G6 (Gloss) | MPI 101 | N/A | MPI 72 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(2) Galvanized surfaces with slight coating deterioration; little or no rusting

| Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| Galvanized Surfaces with slight coating deterioration | Primer | Intermediate | Topcoat | System DFT |
| MPI REX 5.3J-G5 (Semigloss) | MPI 134 | N/A | MPI 163 | 4.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Pigmented Polyurethane | | | | |
|---|---|---|---|---|
| Galvanized Surfaces with slight coating deterioration | Primer | Intermediate | Topcoat | System DFT |
| MPI REX 5.3D-G6 (Gloss) | MPI 101 | N/A | MPI 72 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(3) Galvanized surfaces with severely deteriorated coating or rusting

| Waterborne Light Industrial Coating |
|---|

| Galvanized surfaces with severely deteriorated coating or rusting | Primer | Intermediate | Topcoat | System DFT |
|---|---|---|---|---|
| MPI REX 5.3L-G5(Semigloss) | MPI 101 | MPI 108 | MPI 163 | 8.5 mils |
| MPI REX 5.3L-G6(Gloss) | MPI 101 | MPI 108 | MPI 164 | 8.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Pigmented Polyurethane | | | | |
|---|---|---|---|---|
| Galvanized surfaces with severely deteriorated coating or rusting | Primer | Intermediate | Topcoat | System DFT |
| MPI REX 5.3D-G6(Gloss) | MPI 101 | MPI 72 | MPI 72 | 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

| Alkyd | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.4F-G1 (Flat | MPI 95 | MPI 8 | MPI 8 | 5 mils |
| MPI EXT 5.4F-G5 (Semigloss) | MPI 95 | MPI 94 | MPI 94 | 5 mils |
| MPI EXT 5.4F-G6 (Gloss) | MPI 95 | MPI 9 | MPI 9 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| New Galvanized Surfaces | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.4F-G1 (Flat | MPI 95 | MPI 161 | MPI 161 | 5 mils |
| MPI EXT 5.4F-G5 (Semigloss) | MPI 95 | MPI 163 | MPI 163 | 5 mils |
| MPI EXT 5.4F-G6 (Gloss) | MPI 95 | MPI 164 | MPI 164 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(2) Existing roof surfaces previously coated

| Aluminum Pigmented Asphalt Roof Coating | | | | |
|---|---|---|---|---|
| Existing roof surfaces previously coated | N/A | Intermediate | Topcoat | System DFT |
| Non-MPI System | ASTM D2824/D2824 | N/A | N/A | 8 mils |
| Sufficient coats to provide not less than 8 mils of finished coating system (without asbestos fibers). | | | | |

| Aluminum Paint | | | | |
|---|---|---|---|---|
| Existing roof surfaces previously coated | Primer | Intermediate | Topcoat | System DFT |
| MPI REX 10.2D | MPI 107 | MPI 1 | MPI 1 | 3.5 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

| Alkyd | | | | |
|---|---|---|---|---|
| New | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.1D-G1 (Flat) | MPI 79 | MPI 8 | MPI 8 | 5.25 mils |
| MPI EXT 5.1D-G5 (Semigloss) | MPI 79 | MPI 94 | MPI 94 | 5.25 mils |
| MPI EXT 5.1D-G6 (Gloss) | MPI 79 | MPI 9 | MPI 9 | 5.25 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Waterborne Light Industrial Coating | | | | |
|---|---|---|---|---|
| New | Primer | Intermediate | Topcoat | System DFT |
| MPI EXT 5.1C-G3(Eggshell) | MPI 79 | MPI 161 | MPI 161 | 5 mils |
| MPI EXT 5.1C-G5(Semigloss) | MPI 79 | MPI 163 | MPI 163 | 5 mils |
| MPI EXT 5.1C-G6(Gloss) | MPI 79 | MPI 164 | MPI 164 | 5 mils |
| Primer as recommended by manufacturer.<br>Topcoat: Coating to match adjacent surfaces. | | | | |

3.14.2 Interior Paint Tables

3.14.2.1 MPI Division 3: Interior Concrete Paint Table

A. New and uncoated existing and Existing, previously painted Concrete, vertical surfaces, not specified otherwise

| Latex | | | | | |
|---|---|---|---|---|---|
| New, uncoated Existing | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 3.1A-G2 (Flat) | MPI RIN 3.1A-G2 (Flat) | MPI 3 | MPI 44 | MPI 44 | 4 mils |
| MPI INT 3.1A-G3 (Eggshell) | MPI RIN 3.1A-G3 (Eggshell) | MPI 3 | MPI 52 | MPI 52 | 4 mils |
| MPI INT 3.1A-G5 | MPI RIN 3.1A-G5 (Semigloss) | MPI 3 | MPI 54 | MPI 54 | 4 mils |

| |
|---|
| Topcoat: Coating to match adjacent surfaces. |

| High Performance Architectural Latex | | | | | |
|---|---|---|---|---|---|
| New, uncoated Existing | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 3.1C-G2 (Flat) | MPI RIN 3.1J-G2 (Flat) | MPI 3 | MPI 138 | MPI 138 | 4 mils |
| MPI INT 3.1C-G3 (Eggshell) | MPI RIN 3.1J-G3 (Eggshell) | MPI 3 | MPI 139 | MPI 139 | 4 mils |
| MPI INT 3.1C-G4 (satin) | MPI RIN 3.1J-G4 | MPI 3 | MPI 140 | MPI 140 | 4 mils |
| MPI INT 3.1C-G5 (Semigloss) | MPI RIN 3.1J-G5 (Semigloss) | MPI 3 | MPI 141 | MPI 141 | 4 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

| Institutional Low Odor / Low VOC Latex | | | | | |
|---|---|---|---|---|---|
| New, uncoated Existing | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 3.1M-G2 (Flat) | MPI RIN 3.1L-G2 (Flat) | MPI 149 | MPI 144 | MPI 144 | 4 mils |
| MPI INT 3.1M-G3 (Eggshell) | MPI RIN 3.1L-G3 (Eggshell) | MPI 149 | MPI 145 | MPI 145 | 4 mils |
| MPI INT 3.1M-G4 (satin) | MPI RIN 3.1L-G4 | MPI 149 | MPI 146 | MPI 146 | 4 mils |
| MPI INT 3.1M-G5 (Semigloss) | MPI RIN 3.1L-G5 (Semigloss) | MPI 149 | MPI 147 | MPI 147 | 4 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

3.14.2.2 MPI Division 4: Interior Concrete Masonry Units Paint Table

A. New and uncoated Existing Concrete Masonry

| High Performance Architectural Latex | | | | | |
|---|---|---|---|---|---|
| New, uncoated Existing | Filler | Primer | Intermediate | Topcoat | System DFT |

| | | | | | |
|---|---|---|---|---|---|
| MPI INT 4.2D-G2 (Flat) | MPI 4 | N/A | MPI 139 | MPI 138 | 11 mils |
| MPI INT 4.2D-G3 (Eggshell) | MPI 4 | N/A | MPI 139 | MPI 139 | 11 mils |
| MPI INT 4.2D-G4 (Satin) | MPI 4 | N/A | MPI 140 | MPI 140 | 11 mils |
| MPI INT 4.2D-G5 (Semigloss) | MPI 4 | N/A | MPI 141 | MPI 141 | 11 mils |
| Fill all holes in masonry surface | | | | | |

| Institutional Low Odor / Low VOC Latex | | | | | |
|---|---|---|---|---|---|
| New, uncoated Existing | Filler | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 4.2E-G2 (Flat) | MPI 4 | N/A | MPI 144 | MPI 144 | 4 mils |
| MPI INT 4.2E-G3 (Eggshell) | MPI 4 | N/A | MPI 145 | MPI 145 | 4 mils |
| MPI INT 4.2E-G4 (Satin) | MPI 4 | N/A | MPI 146 | MPI 146 | 4 mils |
| MPI INT 4.2E-G5 (Semigloss) | MPI 4 | N/A | MPI 147 | MPI 147 | 4 mils |
| Fill all holes in masonry surface | | | | | |

B. Existing, Previously Painted Concrete Masonry

| High Performance Architectural Latex | | | | | |
|---|---|---|---|---|---|
| Existing, previously painted | Filler | Primer | Intermediate | Topcoat | System DFT |
| MPI RIN 4.2K-G2 (Flat) | N/A | MPI 138 | MPI 138 | MPI 138 | 4.5 mils |
| MPI RIN 4.2K-G3 (Eggshell) | N/A | MPI 139 | MPI 139 | MPI 139 | 4.5 mils |
| MPI RIN 4.2K-G4 | N/A | MPI 140 | MPI 140 | MPI 140 | 4.5 mils |
| MPI RIN 4.2K-G5 (Semigloss) | N/A | MPI 141 | MPI 141 | MPI 141 | 4.5 mils |

| Institutional Low Odor / Low VOC Latex | | | | | |
|---|---|---|---|---|---|
| Existing, previously painted | Filler | Primer | Intermediate | Topcoat | System DFT |
| MPI RIN 4.2L-G2 (Flat) | N/A | MPI 144 | MPI 144 | MPI 144 | 4 mils |
| MPI RIN 4.2L-G3 (Eggshell) | N/A | MPI 145 | MPI 145 | MPI 145 | 4 mils |
| MPI RIN 4.2L-G4 (Satin) | N/A | MPI 146 | MPI 146 | MPI 146 | 4 mils |
| MPI RIN 4.2L-G5 (Semigloss) | N/A | MPI 147 | MPI 147 | MPI 147 | 4 mils |

3.14.2.3 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, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 5.1R-G2 (Flat) | MPI 76 | MPI 138 | MPI 138 | 5 mils |
| MPI INT 5.1R-G3 (Eggshell) | MPI 76 | MPI 139 | MPI 139 | 5 mils |
| MPI INT 5.1R-G5 (Semigloss) | MPI 76 | MPI 141 | MPI 141 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Alkyd | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 5.1E-G2 (Flat) | MPI 76 | MPI 49 | MPI 49 | 5.25 mils |

| | | | | |
|---|---|---|---|---|
| MPI INT 5.1E-G3 (Eggshell) | MPI 76 | MPI 51 | MPI 51 | 5.25 mils |
| MPI INT 5.1E-G5 (Semigloss) | MPI 76 | MPI 47 | MPI 47 | 5.25 mils |
| MPI INT 5.1E-G6 (Gloss) | MPI 76 | MPI 48 | MPI 48 | 5.25 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

(2) Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations

| Alkyd (over q.d. Alkyd Primer) | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 5.1E-G5 (Semi-Gloss) | MPI 76 | MPI 47 | MPI 47 | 5.25 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| Epoxy | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 5.1L-G6 (Gloss) | MPI 101 | MPI 101 | MPI 101 | 5.25 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

| High Performance Architectural Latex | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 5.4F-G2 (Flat) | MPI 95 | MPI 138 | MPI 138 | 5 mils |
| MPI INT 5.4F-G3 (Eggshell) | MPI 95 | MPI 139 | MPI 139 | 5 mils |
| MPI INT 5.4F-G4 (Satin) | MPI 95 | MPI 140 | MPI 140 | 5 mils |
| MPI INT 5.4F-G5 (Semigloss) | MPI 95 | MPI 141 | MPI 141 | 5 mils |

| |
|---|
| Topcoat: Coating to match adjacent surfaces. |

| Alkyd | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 5.4J-G2 (Flat) | MPI 95 | MPI 49 | MPI 49 | 5 mils |
| MPI INT 5.4J-G3 (Eggshell) | MPI 95 | MPI 51 | MPI 51 | 5 mils |
| MPI INT 5.4J-G5 (Semigloss) | MPI 95 | MPI 47 | MPI 47 | 5 mils |
| MPI INT 5.4J-G6 (Gloss) | MPI 95 | MPI 48 | MPI 48 | 5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

3.14.2.4 MPI Division 6: Interior Wood Paint Table

A. Interior Wood and Plywood

(1) New and Existing, uncoated Wood and plywood not otherwise specified

| High Performance Architectural Latex | | | | |
|---|---|---|---|---|
| New, uncoated Existing | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 6.4S-G3 (Eggshell) | MPI 39 | MPI 139 | MPI 139 | 4.5 mils |
| MPI INT 6.4S-G4 (Satin) | MPI 39 | MPI 140 | MPI 140 | 4.5 mils |
| MPI INT 6.4S-G5 (Semigloss) | MPI 39 | MPI 141 | MPI 141 | 4.5 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

3.14.2.5 MPI Division 9: Interior Plaster, Gypsum Board, Textured Surfaces Paint Table

A. Interior New and Existing, previously painted Plaster and Wallboard not otherwise specified

| Latex |
|---|

| New | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
|---|---|---|---|---|---|
| MPI INT 9.2A-G2 (Flat) | RIN 9.2A-G2 (Flat) | MPI 50 | MPI 44 | MPI 44 | 4 mils |
| MPI INT 9.2A-G3 (Eggshell) | RIN 9.2A-G3 (Eggshell) | MPI 50 | MPI 52 | MPI 52 | 4 mils |
| MPI INT 9.2A-G5 (Semigloss) | RIN 9.2A-G5 (Semigloss) | MPI 50 | MPI 54 | MPI 54 | 4 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

| High Performance Architectural Latex - High Traffic Areas | | | | | |
|---|---|---|---|---|---|
| New | Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
| MPI INT 9.2B-G2 (Flat) | MPI RIN 9.2B-G2 (Flat) | MPI 50 | MPI 138 | MPI 138 | 4 mils |
| MPI INT 9.2B-G3 (Eggshell) | MPI RIN 9.2B-G3 (Eggshell) | MPI 50 | MPI 139 | MPI 139 | 4 mils |
| MPI INT 9.2B-G5 (Semigloss) | MPI RIN 9.2B-G5 (Semigloss) | MPI 50 | MPI 141 | MPI 141 | 4 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | | |

B. Interior New and Existing, previously painted Plaster and Wallboard in restrooms, and other high humidity areas not otherwise specified

Epoxy, New, uncoated Existing

| Epoxy | | | | |
|---|---|---|---|---|
| New, uncoated Existing | 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. | | | | |

Epoxy, Existing, previously painted

| Epoxy |
|---|

| Existing, previously painted | Primer | Intermediate | Topcoat | System DFT |
|---|---|---|---|---|
| MPI RIN 9.2D-G6 (Gloss) | MPI 17 | MPI 77 | MPI 77 | 4 mils |
| Topcoat: Coating to match adjacent surfaces. | | | | |

-- End of Section --

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EXTERIOR SIGNAGE
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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.

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

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 |
| AWS D1.2/D1.2M | (2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum |

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 A924/A924M | (2022) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process |
| 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 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 |

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 lettering, framing as detailed, and related components for a complete installation. Each sample must consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Submit three color samples for each material requiring color and 12 inch square sample of sign face color sample.

1.2.1 Wind Load Requirements

Exterior signage must be designed to withstand 200 mph windload. Submit design analysis and supporting calculations performed in support of specified signage.

1.2.2 Character Proportions and Heights

Letters and numbers on indicated signs for handicapped-accessible buildings must have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs must be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

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

Approved Detail Drawings; G-AE

SD-03 Product Data

Modular Exterior Signage System

Installation

Exterior Signage; G-AE

Wind Load Requirements

SD-04 Samples

Exterior Signage; G-AE

SD-10 Operation and Maintenance Data

Protection and Cleaning

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 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage must consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage must be as shown. Submit manufacturer's descriptive data and catalog cuts.

2.2 DIMENSIONAL BUILDING LETTERS

2.2.1 Fabrication

Letters must be fabricated from extruded aluminum. Letters must be cleaned by chemical etching or cleaned ultrasonically in a special degreasing bath. Letters must be packaged for protection until installation.

2.2.2 Typeface

Typeface must be helvetica medium as indicated.

2.2.3 Size

Letter size must be as indicated.

2.2.4 Finish

Anodized aluminum finish must be provided.

2.2.5 Mounting

Steel U-bracket, cap screws, and expansion bolts of number and size as recommended by manufacturer, must be used for concealed anchorage. Letters which project from the building line must have stud spacer sleeves. Letters, studs, and sleeves must be of the same material. Supply templates for mounting.

2.3 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.

2.4 ANODIC COATING

Anodized finish must conform to AA DAF45 as follows:

Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.4 mil or thicker.

2.5 STEEL PRODUCTS

Structural steel products must conform to ASTM A36/A36M. Sheet and strip steel products must conform to ASTM A1011/A1011M. Welding for steel products must conform to AWS D1.2/D1.2M.

2.6 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.

2.7 SHOP FABRICATION AND MANUFACTURE

2.7.1 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.

2.7.2 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.

2.7.3 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.

2.8 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. 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 six 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.

-- End of Section --

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INTERIOR SIGNAGE

**08/20**

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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 | (2017) Standard And Commentary Accessible and Usable Buildings and Facilities |
| ICC/ANSI A117.1 | (2009) Accessible and Usable Buildings and Facilities |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 101 | (2021) Life Safety Code |

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

| | |
|---|---|
| NIST SP 800-82 | (2015; Rev 2) Guide to Industrial Control Systems (ICS) Security |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| DOD 8510.01 | (2020; Change 1-2020) Risk Management Framework (RMF) for DoD Information Technology (IT) |
| DODI 8500.01 | (2014) Cybersecurity |
| UFC 4-010-06 | (2016; with Change 1, 2017) Cybersecurity of Facility-Related Control Systems |

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-AE

SD-03 Product Data

Room Identification Signage System; G-AE

Stair Signage; G-AE

Exit Door Tactile Sign

SD-04 Samples

Interior Signage; G-AE

Software

Room Identification Signage System; G-AE

Stair Signage; G-AE

Exit Door Tactile Sign; G-AE

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G

Protection and Cleaning; G

## 1.3 EXTRA MATERIALS

Provide 5 extra frames and extra stock of the following: 5 blank plates of each color and size for all sign types included in project. 5 changeable message strips. Provide 5 paper inserts and laser print templates to support end-user printing copy one copy of the software for user produced signs and inserts after project completion.

## 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.

1.4.4 Cybersecurity

a. The Risk Management Framework (RMF) is the process by which information systems are accredited for operation by a designated official from the Using Military Department. It is the standard process under which all DoD information systems achieve and maintain their Authority To Operate. The cybersecurity process is documented in DOD 8510.01 and NIST SP 800-82. Refer to UFC 4-010-06 and DODI 8500.01 for additional requirements.

b. All systems that are IP addressable or interface with the Assured Network required certification to operate. Coordinate with the Government to initiate and complete the accreditation process.

c. Cybersecurity requires input from the system vendor or provider and support from the local IMD. The local IMD-IA office is the point of contact for all Cyber Security requirements. The local CMIO is the point of contact for all clinical and functional system requirements.

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

2.1 ROOM IDENTIFICATION SIGNAGE SYSTEM

Provide signs 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 Modular Sign Systems

Provide manufactured pre- engineered component based sign system designed to create both permanent signs and an updatable sign system that allows for easy and inexpensive updates and changes. Provide a tamper-resistant sign which requires a special tool to change inserts composed of rigid plastic for applied graphics. Sign inserts are required to be front loading.

2.1.2 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.

2.1.3 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.

2.1.4 Type of Mounting for Signs

Surface mounted signs must be mounted with 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive must be transparent, long aging, high tech formulation on two sides of the vinyl foam or hook and loop tape consisting of hooked part on sign back and looped side on mounting surface.

2.1.5 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.

2.3 EXIT DOOR TACTILE SIGN

Provide tactile sign with the message EXIT at each exit door that requires an exit sign to conform with NFPA 101. Sign tactile message is to comply with ICC/ANSI A117.1.

2.4 COLOR, FINISH, AND CONTRAST

Provide color as indicated; 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. Install signs mounted on metal surfaces with magnetic tape.

c. Install signs mounted on fabric surfaces with hook and loop tape or pin mount.

d. Install signs to workstation panels with panel clips.

#### 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.

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WIRE MESH PARTITIONS
**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.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

| | |
|---|---|
| AISI SG03-3 | (2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | (2019) Standard Specification for Carbon Structural Steel |

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

Wire Mesh Partitions; G-AE

Show layout, details, materials, dimensions, finishes, and all information necessary for fabrication and installation.

SD-03 Product Data

Wire Mesh Partitions; G-AE

Submit for each type of partition, door, and window.

Recycled Content for Metal Post and Framing Materials

Recycled Content for Wire Materials

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials in manufacturer's original, unopened containers or packaging with labels intact and legible. Deliver, store, and handle materials so as to prevent damage. Replace damaged or defective materials with new.

1.4 DESCRIPTION OF WORK

Wire mesh partitions must be heavy duty for extra heavy industrial use.

Provide partitions complete with fasteners, capping bars, adjustable floor sockets, bracing, doors, hardware, and other items necessary for a complete, useable, and rigid installation.

## PART 2 PRODUCTS

### 2.1 MATERIALS

Metal post and framing materials listed below must contain a minimum of 15 percent post-consumer recycled content and wire materials must contain a minimum of 50 percent post-industrial recycled content. Provide data identifying percentage of recycled content for metal post and framing materials. Also provide data identifying percentage of recycled content for wire materials.

#### 2.1.1 Steel Shapes, Plates, and Bars

ASTM A36/A36M.

#### 2.1.2 Cold-Formed Steel

AISI SG03-3.

#### 2.1.3 Wire Mesh

Carbon steel wire, woven diamond mesh, intermediate crimped.

#### 2.1.4 Floor Sockets

Cast or forged steel or ductile iron, adjustable, approximately 2-1/2 inches high.

### 2.2 HEAVY DUTY WIRE MESH PARTITIONS

#### 2.2.1 Wire Mesh

6 gage wire, 2 inch mesh.

#### 2.2.2 Panel Frames

1-1/2 by 3/4 by 1/8 inch steel channels.

#### 2.2.3 Center Reinforcing Bar

One 1-1/2 by 3/4 by 1/8 inch channel with all wires woven through, or two 1-1/4 by 3/8 by 1/8 inch channels bolted together with mesh in between.

#### 2.2.4 Capping Bar

Structural steel channel, 3 inch by 4.1 pounds.

#### 2.2.5 Corner Posts

Structural steel angles, 1-3/4 by 1-3/4 by 1/8 inch.

#### 2.2.6 Line Posts

Unless otherwise indicated, provide partitions with flat bar line posts bolted between vertical frame channels. Sizes of posts must be as follows:

| Partition Height | Size of Posts |
|---|---|
| 7 feet to 12 feet | 2-1/2 by 5/16 inch |
| 12 feet to 16 feet | 3 by 5/16 inch or 2-1/2 by 3/8 inch |
| 16 feet to 20 feet | 3-1/2 by 5/16 inch |

2.2.7 Hinged Doors

Frames must be 1-1/2 by 3/4 by 1/8 inch channels with 1-1/2 by 1/8 inch flat bar cover on top and bottom rails and on hinge stile and a 1-5/8 by 7/8 by 1/8 inch angle riveted to the lock stile. Provide 1-1/2 pairs of heavyweight, wrought steel, non-removable pin, butt hinges riveted or welded to the door and the door opening frame for each door.

2.3 DOOR OPENING FRAMES

Provide frames the same size and shape as the vertical frames for the mesh panels.

2.4 LOCKS

Provide each door with a mortise type lock with a six-pin tumbler lock cylinder on the outside and a recessed knob on the inside.

2.5 FABRICATION

2.5.1 Standard Panels

Wire must be woven into diamond mesh, intermediate crimped, and securely clinched to frames. Joints must be mortised and tenoned. Wire must be continuous at center reinforcing bars, either woven through a single channel or bolted between two channels. Panel vertical frames must have 3/8 inch bolt holes 18 inches o.c. for heavy duty partitions.

2.5.2 Sheet Metal Base Panels

Upper portion must be as specified for standard panels, except that the wire must be clinched into the center reinforcing bar. Form sheet steel to fit between the panel frames and securely bolt to the frames.

2.5.3 Doors

Construction must be similar to that specified for panels. Wire mesh must be the same as that used in the adjacent partition panels.

2.5.4 Finish

Thoroughly clean ferrous metal, treat with phosphate, and paint with gray enamel in the shop.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wire Mesh Partitions

Install plumb, level, and true to line, within a tolerance of 1/8 inch in

10 feet or the height or run of the partition, if less than 10 feet. Anchor floor sockets to the floor with expansion bolts. Bolt vertical frames and posts together with 3/8 inch bolts 18 inches o.c. for heavy duty partitions. Secure top frames to a continuous capping bar with 1/4 inch diameter U bolts not more than 28 inches o.c.

3.1.2 Doors

Install in accordance with the manufacturers' recommendations. Adjust as required so that doors and hardware operate freely and properly.

3.1.3 Bracing

Brace free standing partitions more than 20 feet in length, at intervals not greater than 20 feet with a structural steel I section or tube post welded to a 9 by 9 inch steel base plate anchored to the floor with 4 expansion bolts.

3.1.4 Touch-Up

Clean and paint scratches, abrasions, and other damage to shop painted surfaces to match the shop-applied finish.

Repair minor surface rust areas. Clean and prime with rust inhibitive primer paint. Apply final paint to match shop-applied finishes.

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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.

ALUMINUM ASSOCIATION (AA)

| | |
|---|---|
| AA DAF45 | (2003; Reaffirmed 2009) Designation System for Aluminum Finishes |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| 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; R 2021; E 2021) 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 |

GREEN SEAL (GS)

| | |
|---|---|
| GS-36 | (2013) Adhesives for Commercial Use |

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

| | |
|---|---|
| SCS | SCS Global Services (SCS) Indoor Advantage |

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 |

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

Corner Guards; G-AE

SD-03 Product Data

Corner Guards; G-AE

Wall Covering and Panels; G-AE

SD-04 Samples

Corner Guards; G-AE

SD-06 Test Reports

Fire Resistance Rating

SD-07 Certificates

Indoor air quality for wall covering/panelsIndoor air quality for adhesives

SD-10 Operation and Maintenance Data

Corner Guards, Data Package 1; G-RO

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality

1.3.1.1 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 program 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 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.

1.5 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 and door protection items that are standard products of a single manufacturer and furnished as detailed. Drawings show general configuration of products required.

Submit detailed shop drawings of each wall and door protection item indicated. Include elevations, dimensions, clearances, details of construction and anchorage, and details of joints and connections.

Submit manufacturers' descriptive product data for each wall and door protection item indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each wall and door protection item indicated in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

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

Provide flush mounted corner guards, radius formed to profile shown. Provide corner guards that extend from floor to align with top of adjacent door frame. 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. Flush mounted type guards act as a stop for adjacent wall finish material. Furnish factory fabricated end closure caps for top and bottom of surface mounted corner guards. 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.

2.3 WALL COVERING AND PANELS

Provide wall covering and panels consisting of high impact PVC free resilient material. 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.

## 2.4 FINISH

Submit samples indicating color and texture of materials requiring color and finish.

### 2.4.1 Aluminum Finish

Provide aluminum finish accordance with AA DAF45; exposed aluminum with designation AA-C22A31 chemically etched medium matte, with clear anodic coating. Provide Class II architectural coating that is 0.4 mil thick. Provide concealed aluminum with mill finish as fabricated, uniform in natural color and free from surface blemishes.

### 2.4.2 Resilient Material Finish

Provide resilient material finish of embossed stipple texture with colors in accordance with SAE J1545.

## 2.5 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.

## 2.6 COLOR

Provide color as indicated on 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 and Wall Guards

a. Mount guards as indicated and in accordance with manufacturer's written installation instructions.

b. For wall guards, space brackets at no more than 3 feet on centers and anchor to the wall in accordance with the manufacturer's written installation instructions.

### 3.1.2 Wall Coverings and Panels

Install as indicated in accordance with manufacturer's written instructions.

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TOILET ACCESSORIES

**08/20**

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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.

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-AE

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

Item A5030 Bench, Stall, Shower, Built In; G-AE

Item A5080 Dispenser, Paper Towel, SS, Surface Mounted; G-AE

Item A5090 Disposal, Sanitary Napkin, SS, Surface Mounted; G-AE

Item A5109 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, W/C Accessible; G -AE

Item A5110 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, Shower Use; G-AE

Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mntd; G-AE

Item A5145 Hook, Garment, Double, SS, Surface Mounted; G-AE

Item A5170 Rod, Shower Curtain, 1 inch Diameter, W/Curtain & Hooks; G-AE

Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mntd; G-AE

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-10 Operation and Maintenance Data

Item A5030 Bench, Stall, Shower, Built In; G-RO

Item A5080 Dispenser, Paper Towel, SS, Surface Mounted; G-RO

Item A5090 Disposal, Sanitary Napkin, SS, Surface Mounted; G-RO

Item A5109 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, W/C Accessible; G -RO

Item A5110 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, Shower Use; G-RO

Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mntd; G-RO

Item A5145 Hook, Garment, Double, SS, Surface Mounted; G-RO

Item A5170 Rod, Shower Curtain, 1 inch Diameter, W/Curtain & Hooks; G-RO

Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mntd; G-RO Submit Data Package 1 for each toilet accessory item in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

## 1.3 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.

## 1.4 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 oval heads 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 Item A5030 Bench, Stall, Shower, Built-In

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 Item A5080 Dispenser, Paper Towel, SS, Surface Mounted

Surface mounted unit constructed of stainless steel with satin finish, welded construction, and have full length piano hinge, tumbler lock, refill indicator. Unit has smooth corners, free of burrs and sharp edges. Unit has a capacity of 400 single fold paper towels.

Approximate size: 11 inches wide by 8 inches high by 6 inches deep.

2.1.5 Item A5090 Disposal, Sanitary Napkin, SS, Surface Mounted

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.

2.1.6 Item A5109 Grab Bar, 1-1/4 Inch Diameter, SS, 2 Wall, W/C Accessible

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.

2.1.7 Item A5110 Grab Bar, 1-1/4 Inch Diameter, SS, 2 Wall, Shower Use

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.

2.1.8 Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mounted

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.

2.1.9 Item A5145 Hook, Garment, Double, SS, Surface Mounted

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.

2.1.10 Item A5170 Rod, Shower Curtain, 1 Inch Diameter, W/Curtain & Hooks

Shower Curtain Rod with concealed mounting. Shower curtain rod made of satin finish stainless steel, 1 inch diameter, with flanges included, and have white vinyl shower curtain, 72 inches high, and stainless steel curtain hooks. Shower curtain has corrosion resistant grommets, reinforced heading, and treated with antibacterial and flame retardant agents. Shower hooks are stainless steel. Length as indicated on drawings.

2.1.11 Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mounted

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.

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 --

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FIRE EXTINGUISHERS

**11/19**

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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 |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 1 | (2021) Fire Code |
| NFPA 10 | (2022; ERTA 1 2021) Standard for Portable Fire Extinguishers |
| NFPA 101 | (2021) Life Safety Code |
| NFPA 505 | (2018) Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.157 | (2003) Portable Fire Extinguishers |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 299 | (2012; May 2021) Dry Chemical Fire Extinguishers |
| UL 2129 | (2017; Reprint Apr 2021) UL Standard for Safety Halocarbon Clean Agent Fire Extinguishers |

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

Fire Extinguishers

Accessories

Cabinets

Wall Brackets

Schedule

SD-03 Product Data

Fire Extinguishers

Accessories

Cabinets

Wall Brackets

Replacement Parts List

SD-04 Samples

Equipment Samples

SD-07 Certificates

Fire Extinguishers Certifications

Manufacturer's Warranty with Inspection Tag; G

## 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.

Provide portable fire extinguishers in compliance with NFPA 505 for all ancillary vehicles where Fire Safety Standard for Powered Industrial Trucks, including type designations, special conditions relating to areas of use, conversions, maintenance, or specific operations apply.

### 1.3.1 Samples

Provide the following equipment samples: One of each type of fire extinguisher being installed; one full-sized sample of each type of cabinet being installed; three samples of wall brackets and accessories of each type being used.

Use approved samples for installation, with proper identification and storage.

## 1.4 WARRANTY

Guarantee that Fire Extinguishers are free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than 6 years after completion.

Submit the manufacturer's warranty with inspection tag.

1.5 PROJECT SCHEDULE

For fire extinguishers. 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: Fire Extinguishers; Accessories, cabinets, Wall Brackets.

2.1 SYSTEM DESCRIPTION

2.1.1 Types

Submit fire extinguishers certifications showing compliance with local codes and regulations.

Provide fire extinguishers conforming to NFPA 10. Provide quantity and placement in compliance with the applicable sections of NFPA 1, NFPA 101, and 29 CFR 1910.157.
Provide dry chemical type fire extinguishers compliant with UL 299.

Provide clean agent type fire extinguishers compliant with UL 2129.

2.1.2 Material

Provide enameled steel extinguisher shell.

2.1.3 Size

5 or 10 pounds extinguishers.

2.2 EQUIPMENT

2.2.1 Cabinets

2.2.1.1 Material

Provide enameled steel cabinets.

2.2.1.2 Type

Provide semi-recessed cabinet for a partition depth as indicated on the drawings.

Provide a fire rated cabinet, listed and labeled to comply with ASTM E814 for fire resistance wall rating.

2.2.1.3 Size

Dimension cabinets to accommodate the specified fire extinguishers.

2.2.2 Wall Brackets

Provide wall-hook fire extinguisher wall brackets.

Provide wall bracket and accessories as approved.

2.2.2.1 Identification

Provide lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by the drawings.

Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.

Orientation: Vertical.

PART 3 EXECUTION

3.1 INSTALLATION

Install Fire Extinguishers where indicated on the drawings. Verify exact locations prior to installation.

Provide extinguishers which are fully charged and ready for operation upon installation. Provide extinguishers complete with Manufacturer's Warranty with Inspection Tag attached.

Install fire extinguishers in locations indicated 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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DIVISION 10 - SPECIALTIES

SECTION 10 51 13

METAL LOCKERS

**05/11**

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SECTION 10 51 13

METAL LOCKERS
**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.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| 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 |

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" 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

Types; G-AE

Location; G-AE

Installation

Numbering system

SD-03 Product Data

Material

Handles

Finish

Locker components

Assembly instructions

SD-04 Samples

Color chips; G-AE

1.3 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.

1.4 FIELD MEASUREMENTS

To ensure proper fits, make field measurements prior to the preparation of drawings and fabrication. Verify correct location

1.5 QUALITY ASSURANCE

1.5.1 Color Chips

Provide a minimum of three color chips, not less than 3 inches square, of each color indicated.

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

Locker must have the following type and size in the location and quantities indicated. Locker finish colors will be as scheduled.

2.1.1 Single-tier Lockers

Single-tier lockers must be as follows:

Single-tier locker 18 inches wide, 21 inches deep, and 72 inches high, attached to 6-inch high closed base

2.2 MATERIAL

2.2.1 Steel Sheet

ASTM A1008/A1008M ASTM A568/A568M, commercial quality, minimized spangle material. Prepare material surfaces for baked enamel finishing in accordance with FS AA-L-00486. Fabricate locker bodies from not less than 0.0239-inch thick steel sheet.

2.2.2 Finish

FS AA-L-00486.

2.2.2.1 Color

As selected.

## 2.3 COMPONENTS

### 2.3.1 Coat Hooks

FS AA-L-00486, chromium plated.

### 2.3.2 Door Handles

FS AA-L-00486. Provide zinc alloy or steel handles with a chromium coating.

### 2.3.3 Doors

FS AA-L-00486, not less than 0.0598 inch thick steel sheet.

#### 2.3.3.1 Hinges

In addition to the requirements of FS AA-L-00486, provide 5-knuckle hinges, minimum 2 inches high. Fabricate knuckle hinges from not less than 0.0787 inch thick steel sheet. A full height piano hinge may be provided if standard with the manufacturer. Weld or bolt hinges to the door frame. Weld, bolt, or rivet hinges to the door.

#### 2.3.3.2 Latching Mechanisms

FS AA-L-00486.

### 2.3.4 Latch Strikes

FS AA-L-00486. Fabricate from not less than 0.0787 inch thick steel sheet, except latch strike may be continuous from top to bottom and fabricated as part of the door framing.

### 2.3.5 Silencers

FS AA-L-00486.

### 2.3.6 Back and Side Panels, Tops, and Bottoms

FS AA-L-00486, not less than 0.0474 inch thick steel sheet.

### 2.3.7 Sloping Locker Tops

Provide sloping locker tops in addition to the locker-section flat tops. Sloping tops must be continuous in length. Provide fillers or closures at the exposed end of sloping tops. Fabricate sloping tops from not less than 0.0478-inch thick steel sheet.

### 2.3.8 Shelves

FS AA-L-00486. Fabricate from not less than 0.0598 inch thick steel sheet.

### 2.3.9 Base Panels

FS AA-L-00486.

2.3.10 Number Plates

FS AA-L-00486. Aluminum. Provide consecutive numbers from 1 to 20.

2.3.11 Fastening Devices

Provide bolts, nuts, and rivets as specified in FS AA-L-00486.

PART 3 EXECUTION

3.1 ASSEMBLY AND INSTALLATION

Assemble lockers according to the locker manufacturer's instructions. Align lockers horizontally and vertically. Secure lockers to wall with screws as indicated. Bolt adjacent lockers together. Adjust doors to operate freely without sticking or binding and to ensure they close tightly.

3.2 NUMBERING SYSTEM

Install number plates on lockers consecutively.

3.3 FIELD QUALITY CONTROL

3.3.1 Testing

Government may request performance-characteristic tests on assembled lockers in accordance with FS AA-L-00486. Lockers not conforming will be rejected.

3.3.2 Repairing

Remove and replace damaged and unacceptable portions of completed work with new.

3.3.3 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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ATTACHMENTS:

Furniture, Fixtures and Equipment (FF&E) Package

-- End of Section Table of Contents --

SECTION 12 50 00.13 10

FURNITURE AND FURNITURE INSTALLATION
**08/17, CHG 1: 11/18**

PART 1 GENERAL

Purchase and install furniture as identified within this specification. This specification section includes a Furniture, Fixtures and Equipment (FF&E) Package attachment.

The requirements of this specification also apply to systems furniture.

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 90.1 - IP | (2019; Errata 1 2019; Errata 2-6 2020; Addenda BY-CP 2020; Addenda AF-DB 2020; Addenda A-G 2020; Addenda F-Y 2021; Errata 7-8 2021; Interpretation 1-6 2021; Addenda AS-BF 2022) Energy Standard for Buildings Except Low-Rise Residential Buildings |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D4157 | (2013; R 2017) Standard Test Method for Abrasion Resistance of Textile Fabrics (Oscillatory Cylinder Method) |
| ASTM E84 | (2020) Standard Test Method for Surface Burning Characteristics of Building Materials |

BIFMA INTERNATIONAL (BIFMA)

| | |
|---|---|
| ANSI/BIFMA X5.1 | (2017) American National Standards For Office Furnishings - General Purpose Office Chairs |
| ANSI/BIFMA X5.3 | (2007; R2012) American National Standards For Office Furnishings - Vertical Files |
| ANSI/BIFMA X5.4 | (2012) American National Standards For Office Furnishings - Lounge Seating |
| ANSI/BIFMA X5.5 | (2014) American National Standards For Office Furnishings -Desk Products |
| ANSI/BIFMA X5.6 | (2016) American National Standards For |

| | |
|---|---|
| | Office Furnishings -Panel Systems |
| ANSI/BIFMA X5.9 | (2012) American National Standards For Office Furnishings - Storage Units |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 101 | (2021) Life Safety Code |
| NFPA 260 | (2013) Standard Methods of Tests and Classification System for Cigarette Ignition Resistance of Components of Upholstered Furniture |
| NFPA 265 | (2019) Standard Methods of Fire Tests for Evaluating Room Fire Growth Contribution of Textile or Expanded Vinyl Wall Coverings on Full Height Panels and Walls |

STATE OF CALIFORNIA DEPARTMENT OF CONSUMER AFFAIRS, BUREAU OF ELECTRICAL AND APPLIANCE REPAIR, HOME FURNISHINGS AND THERMAL INSULATION (BEARHFTI)

| | |
|---|---|
| TB 117-2013 | (2013) Requirements, Test Procedure and Apparatus for Testing the Smolder Resistance of Materials Used in Upholstered Furniture |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| 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)

| | |
|---|---|
| 36 CFR 1191 | Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 723 | (2018) 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 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

Storage Location

SD-02 Shop Drawings

Installation Drawings; G-AE

SD-03 Product Data

Product Data

Product Style Options

SD-04 Samples

Fabric and Finishes; G-RO

SD-07 Certificates

Authorized Dealer

Certified Furniture Installers

Licensed Electrician

Certified Telecommunications Installer

Manufacturer's Certification

Warranty

SD-10 Operation and Maintenance Data

Furniture, Data Package 1; G-RO

SD-11 Closeout Submittals

Energy Efficient Equipment

Reduced VOC's for Furniture

Recycled Content of Furniture

Bio-Based Content of Furniture

1.3 SERVICES

Provide services to include furniture purchase, field measuring, installation drawings, shipping and delivery coordination, receiving, inspection, submitting and processing freight and warranty claims, unpacking, storing, assembly, installation and other related activities or tasks for a complete and functional installation. Reference Section 01 45 00.00 10 QUALITY CONTROL for inspection requirements. The Contracting Officer must be allowed to participate in inspections. Develop project timelines and establish shipping, receiving and installation dates that coordinate with the building construction schedule. Hold at a minimum weekly team meetings to brief the project team, include the Contracting Officer. Notify the Contracting Officer immediately of any scheduling problems, discontinued furniture items including fabrics and finishes, or other conditions which may cause

delays, and recommend available substitutes, solutions, and provide updated timeline to coordinate with building construction schedule. Substitutes and solutions must comply with the specification and be approved by the Contracting Officer.

1.4 FURNITURE PURCHASE

Purchase furniture, including checking accuracy of all acknowledgements and schedules from manufacturers and making necessary corrections to insure that the manufacturer has a correct understanding of the order and requirement. Provide furniture from the GSA Schedules and provide GSA pricing. Provide furniture from open market only when an item is not available on the GSA Schedules. See FAR clause 52.251-1 Government Supply Sources. Purchase furniture from the open market. The furniture provided needs to be available on the GSA Schedules to assist the User with future purchases. Compete the furniture purchase by obtaining a minimum of (3) separate proposals. Furniture is subject to FAR clause 52.236-5 Materials and Workmanship. If necessary to meet project timeline requirements, furniture may be purchased using manufacturers quick-ship programs or by coordinating factory times.

1.5 ALTERNATE DESIGN

When a manufacturer's product is unable to provide desk and workstation configurations and filing/storage that conform exactly to the furniture layouts shown in the contract drawings and specifications, alternate designs may be submitted for consideration by the Contracting Officer. Alternate designs must meet or exceed the following criteria. Alternate designs that are submitted but do not meet these criteria will be rejected.

1.5.1 Desk and Workstation Size and Configuration

The alternate design must provide desks and workstations of the same basic size and configuration shown, with only the sizes of the individual components within the desk and workstation changed to meet the standard product of the manufacturer.

1.5.2 Filing and Storage Size and Configuration

The alternate design must provide filing and storage of the same basic size and configuration shown, with only the size changed to meet the standard product of the manufacturer. The storage capacity must not be reduced.

1.5.3 Furniture Requirements

The furniture provided must comply with the drawings, specifications, and the requirements identified in the FF&E Package Attachment.

1.5.4 Layout

The storage capacity, number of desks and workstations, number of persons accommodated, width of aisles, and functionality must be maintained. Layout must comply with NFPA 101 and 36 CFR 1191.

1.6 AUTHORIZED DEALER, CERTIFIED FURNITURE INSTALLERS, LICENSED ELECTRICIAN AND CERTIFIED TELECOMMUNICATIONS INSTALLER

When required by the furniture manufacturer, furniture must be installed

by an authorized dealer and a certified furniture installation crew must be used on the project. All furniture requiring hardwiring must be completed by a licensed electrician. Communications installers must be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level or have a minimum of 3 years experience in the installation of the specified cables and components. All installers, furniture, electrical and communications, must be on-site if questions arise. Submit copies of authorized dealer, furniture installation crew, licensed electrician and certified telecommunications installer certifications.

## 1.7 DELIVERY, STORAGE AND HANDLING

### 1.7.1 Delivery

Deliver furniture to the jobsite in manufacturer's original packaging or blanket wrapping. Original packaging must be marked with the manufacturer name, item identification, and project reference clearly marked.

### 1.7.2 Furniture Inspection

Inspect furniture and provide notification of damage within the time frame required by the shipping company while carrier is still on-site. Complete claims for concealed damage within the time frame required by the shipping company and furniture manufacturer. A claim file must be maintained that documents each claim. Forward copies of claims to the Contracting Officer on a daily basis.

### 1.7.3 Storage

Storage space is not available on-site and furniture must be stored at an off site location. Provide any storage space required for furniture and transport stored furniture to the project site for installation. Storage location must be approved by the Contracting Officer at the time of the furniture order. If storage is required, furniture must be stored in a dry location that is adequately ventilated and free from dirt and dust, water, and other contaminants, in a manner that permits easy access for inspection and handling, and in an environment in accordance with furniture manufacturers instructions.

### 1.7.4 Furniture Staging Area

Coordinate location of the furniture staging area with the Contracting Officer.

## 1.8 WARRANTY

Provide manufacturer performance guarantees or warranties for single-shift service and include parts, labor and transportation as follows, unless otherwise noted:

a. Systems Furniture - 12 year minimum

b. Desks and Workstations - 12 year minimum

c. Filing and Storage - 12 year minimum

d. Seating

(1) Seating, unless otherwise noted - 10 year minimum

(2) 24/7 Seating (multiple shift use) - 10 year minimum

(3) Seating Mechanisms and Pneumatic Cylinders - 10 year minimum

(4) Lounge Seating - 10 year minimum

(5) Stacking Chairs - 10 year minimum

e. Tables

(1) Unless otherwise noted - 10 year minimum

(2) Table Mechanisms - 5 year minimum

(3) Table Ganging Device - 1 year minimum

f. Miscellaneous

(1) Fabric - 3 year minimum

(2) LED Task Lighting - 5 year minimum

(3) Task Lighting - 2 year minimum

Provide items not listed with a 1 year minimum. When manufacturers standard performance guarantees or warranties exceed the minimum requirements identified, provide the standard performance guarantee or warranty. Submit manufacturer's warranty information for all furniture items.

## 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

Coordinate requirement for energy efficient equipment, such as appliances and lighting, and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

#### 2.1.2 Reduced VOC's for Furniture

Coordinate requirement for reduced VOC requirements for furniture and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS.

#### 2.1.3 Recycled Content of Furniture

Coordinate requirement for recycled content for furniture and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph RECYCLED CONTENT.

2.1.4 Bio-Based Content of Furniture

Coordinate requirement for biobased content for furniture and provide documentation in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph BIO-BASED PRODUCTS.

2.2 REFERENCE TO MANUFACTURER NAMES AND COLORS

Where product and color is shown as being specific to one manufacturer in the FF&E Package Attachment, an equivalent color or product by another manufacturer may be submitted for approval. Manufacturers, style lines, model numbers, finish, and fabric information are provided to establish design intent and are not intended to limit the selection of equal products and colors from other manufacturers.

2.3 FURNITURE REQUIREMENTS

Use the FF&E Package Attachment in conjunction with the drawings and specifications for the furniture requirements. Provide furniture from manufacturer's standard product as shown in the most current published price list or amendment. Furniture provided must be part of current line as indicated with no intent to discontinue within two years. Provide furniture that is intended for commercial use not residential. submit product data for all furniture items, to include catalog cuts, brochures, product information, and other necessary literature to indicate compliance with specifications. Provide product data for all items together in a single submittal. Provide product data for all similar types of items together as a group, such as desks/workstations, seating, storage, and tables. Submit each grouping of similar type items in a single submittal. When applicable, include GSA schedule information to confirm that items are available on GSA schedule. Tag product data sheets with applicable furniture item code and name. Submit data for all product style options for selection when options are available. This applies to but is not limited to furniture items that have options such as edge details, hardware options, and grommet colors. Submit manufacturer's certification stating that furniture meets the specifications.

2.3.1 Construction

a. Provide furniture that complies with the following testing requirements:

(1) ANSI/BIFMA

(a) Office Seating - ANSI/BIFMA X5.1

(b) Vertical Files - ANSI/BIFMA X5.3

(c) Lounge Seating - ANSI/BIFMA X5.4

(d) Desk Products - ANSI/BIFMA X5.5

(e) Panel Systems - ANSI/BIFMA X5.6

(f) Storage - ANSI/BIFMA X5.9

(2) Flammability

(a) Systems furniture and workstation panel components must meet

requirements for flame spread and smoke development as specified by NFPA 101 except as follows. Conduct testing in accordance with either ASTM E84 or UL 723 on the entire assembled panel of the worst case (most combustible) combination of fabric and interior construction. In addition, fabric must meet the requirements of NFPA 265. Panel flame spread shall not exceed 25 for Class A, and panel smoke development shall not exceed 450 for Class A, B, and C.

(b) Upholstered furniture must comply with TB 117-2013 or NFPA 260.

b. Provide furniture with no rough or sharp edges or exposed connections. Clips, screws, and other construction elements must be concealed wherever possible.

c. Items such as desks, workstations and systems furniture must include all necessary components to be structurally sound and must not be attached to the wall unless specified to be wall mounted in the contract documents.

d. Desks, workstations, storage, and tables must have leveling devices to compensate for uneven floors.

e. The underside of desks, workstations, and tables must be completely and smoothly finished.

f. The backside of freestanding desks, workstations, and tables must be finished.

g. Provide chair casters and glides appropriate for the floor material they are located on, such as carpet and resilient flooring.

2.3.2 Locks and Keying

a. All drawers and doors, including but not limited to overhead storage cabinets, storage towers, supply cabinets, storage cabinets, desk and workstation pedestals, and filing cabinets must be lockable.

b. Key each desk and workstation in an office differently and key locks within each desk and workstation alike.

c. Furniture storage components in private offices must be keyed alike. Key each private office differently.

d. Provide field changeable lock cylinders in desks and workstations with a minimum of 100 different key options. Number keys and lock cylinders for ease of replacement or clearly label locks with a key number, except for those manufacturers who have removable format locks.

e. Drawers within a pedestal must be lockable either by a central lock that controls all pedestals under one work surface or an individual keyed lock in each pedestal.

f. Central file and storage units which are grouped together but are not a part of a workstation must be keyed differently unless otherwise specified.

g. Provide two keys for each workstation when components are keyed alike. Also provide two keys for each miscellaneous item such as filing cabinets, supply cabinets, storage cabinets, and similar type

furniture items.

h. Provide three copies of each master key to the Contracting Officer.

i. Inventory keys, label keys by lock number, room number and furniture item and turn over inventory and keys to the Contracting Officer.

2.3.3 Receptacle Bodies and Device Cover Plates

Provide furniture panel faceplates and receptacle body types and color as specified in FF&E Package. Provide color as follows:

a. Faceplate: match panel trim color

b. Receptacle Bodies: match panel trim color

c. Communication Cable Jackets: match receptacle device cover plates in color

d. Isolated Ground Receptacles: orange

2.3.4 Fabric and Finish

Submit samples of all furniture fabric and finishes. Samples must be actual samples, not photographic representations, size must be a minimum of 3 by 3 inches. If necessary, provide larger size samples to clearly represent pattern. Label samples with fabric or finish code, furniture item code and name, manufacturer name, and color information. Fabric samples must also be labeled with fiber content and double rub testing information.

2.3.4.1 Fabric

a. Fabric must be from manufacturer's standard line and, graded-in textile manufacturer's fabrics. Do not provide COM fabrics.

b. Provide a mid grade fabric, unless otherwise noted. Example: manufacturer available grades 1 through 4 (even number of grades), provide grade 3; manufacturer available grades A through D (even number of grades), provide grade C; manufacturer available grades A through E (odd number of grades), provide grade C (middle grade).

c. Provide a topical or inherent soil retardant treatment where indicated.

d. Fabric for seating must comply with a minimum of 55,000 double rubs unless otherwise noted. Perform double rub testing in accordance with the ASTM D4157 Wyzenbeek Method.

e. Provide vinyl, polypropylene or similar type fabric for seating only if allowed in FF&E Package Attachment.

f. Pattern:

(1) Provide patterned upholstery fabric to help hide soiling. Pattern is defined as follows:

(a) Solid Color: textured

(b) Small Size Pattern: minimum 1/2 inch

(c) Medium Size Pattern: minimum 2 inch

(d) Large Size Pattern: minimum 5 inch

g. See FF&E Package Attachment for additional information.

2.3.4.2 Finishes

Provide furniture finishes as listed below unless otherwise noted:

a. Finishes must be able to be cleaned with ordinary household cleaning solutions. Wood finishes must be able to be cleaned with damp cloth as directed by the manufacturer.

b. The finish of steel surfaces must be the manufacturer's most durable finish such as factory powder coat or baked enamel.

c. Grommet colors must be compatible and coordinated with desk, workstation, and table finish colors.

d. Plastic laminate worksurfaces and table tops must be neutral in color and must have a pattern to help hide soiling.

e. See FF&E Package Attachment for additional information.

2.4 FURNITURE LAYOUT

Provide furniture layout as indicated.

PART 3 EXECUTION

3.1 BUILDING EXAMINATION

Become familiar with details of the work, inspect all areas and conditions under which furniture is to be installed, and coordinate scheduling of dedicated elevators and docks. 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.

3.2 BUILDING PROTECTION

Protect building surfaces to prevent soiling and damage during delivery and installation. Any soiling and damage that occurs to the building during the installation of furniture must be cleaned and repaired, or replaced to its original condition and must be approved by the Contracting Officer.

3.3 INSTALLATION

3.3.1 Installation Drawings

Installation drawings must include furniture layout, critical dimensions and locations of electrical and communications. Furniture layouts shall reflect field verified conditions. Drawings must be at 1/4 inch = 1 foot scale, unless otherwise specified. Provide typical plans and isometrics/elevations of desks and workstations at a scale of 1/2 inch = 1 foot. When applicable, provide desk and workstation electrical and communications locations. When applicable include controlled-circuit

identification for each furniture receptacle and coordinate with the building electrical system circuits in accordance with ASHRAE 90.1 - IP. Critical dimensions include, but are not limited to clearances and aisle widths. Drawings must include layout for furniture systems workstations for coordination purposes. Label furniture with furniture item code identified in this specification. Submit grommet, power and communication units, and wire management locations.

3.3.2 Furniture Installation Procedures

Complete installation in accordance with manufacturer's installation instructions, assembly manuals, warranty requirements and approved installation drawings. Also comply with the following requirements:

a. Use material handling equipment with rubber wheels.

b. Furniture and components must be installed level, plumb, square, and with proper alignment with adjoining furniture.

c. Match keys to locks and check locking mechanisms.

d. Check drawers, doors, lighting, and other operable items and mechanisms for proper operation.

e. Remove all protective wrapping tape, residue, and related type items.

f. Securely interconnect furniture components where required.

g. Securely attach and anchor furniture components to the building when required.

h. Securely anchor furniture such as shelving and storage units to the building when required by the manufacturer.

i. All items with an electrical plug, such as but not limited to task lighting and tables with electrical power, must be fully operational.

j. All hardwired furniture, such as but not limited to furniture systems, must be fully operational. Verify that voltage is present in electrical outlets. Verify controlled-circuit outlets are properly configured in accordance with the installation drawings.

k. Furniture must not block SIPRNET and NIPRNET jacks or the jack enclosures on walls. Report conflicts to Contracting Officer to discuss resolution.

l. Upon completion of installation, all furniture must be completely cleaned, finished, leveled, aligned, operational and functional.

3.3.3 Furniture Communications Installation

Provide all Information/Technology (IT) cables (i.e. SIPRNET, NIPRNET, J-WIC'S, etc.) and phone wiring up to and including the face plate/box of all furniture as required and the services to install the cables, wiring and face plates/boxes in the furniture. Coordinate cable type, cable jacket and outlet jack color with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. Furniture communication installers must be on site to install communication cables, wiring and other components for furniture during furniture installation. Coordinate the

TIA-568-C.2 pin/pair assignments for communication outlets to match the configuration of the building's non-furniture outlets; coordinate with Contracting Officer. All items with a communication interface must be fully operational.

## 3.4 CLEANING

Remove all packing materials and other trash from the jobsite. Upon completion of installation, all products must be clean, including inside all drawers and doors, and the area must be free of debris and left in a clean and neat condition. Any defects in or damage to furniture must be repaired or replaced and approved by the Contracting Officer. Damaged products that cannot be satisfactorily repaired must be replaced. Correct any problems with assembly and installation. Prior to any furniture repair, replacement, and/or assembly and installation corrections, protect the building surfaces.

## 3.5 OPERATION AND MAINTENANCE MANUALS

Submit the Furniture, Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and include the following:

### 3.5.1 Assembly Manuals

Describe assembly and re-configuration procedures. Provide three sets of installation video tapes if available.

### 3.5.2 Installation Instructions

Provide a copy of the instructions used to install the furniture. Also describe any special procedures or helpful hints learned during the installation process.

### 3.5.3 Maintenance Manuals

Describe proper cleaning and minor repair procedures, include cleaning instructions for fabrics.

### 3.5.4 Electrical System Manuals

Describe the functions, configuration, and maintenance of the furniture electrical system (power, communication, and data). This information may be included in the assembly or maintenance manuals.

### 3.5.5 Special Tools

Provide three sets of special tools necessary for assembly and disassembly of furniture and components from each manufacturer. Mark tool(s) with manufacturer and product information.

### 3.5.6 Furniture Drawings

Provide hard copy and electronic, showing installed furniture layout. Include all modifications. Provide electronic copies on a CD-ROM. Coordinate type (such as but not limited to Microstation, AutoCad and Revit) and version required with User. Include critical dimensions, and locations of building and furniture electrical and communications. Provide drawings at 1/4 inch = 1 foot scale, unless otherwise specified. Provide typical plans and isometrics/elevations of workstations at a scale of 1/2

inch = 1 foot. Code all furniture with furniture item code identified in this specification.

3.5.7 Furniture Listing

Provide complete listing, hard copy and electronic, of furniture provided. Include all modifications. Provide electronic copies on a CD-ROM. Coordinate type of electronic file required with User (such as but not limited to Word and Excel). Listing must include furniture item code and name used in FF&E Package, part/model numbers, fabrics and finishes for all components furnished. Organize listing by item name and code and provide building totals.

3.5.8 Order Form Documentation

Provide Order Form Documentation with Purchase Order number and project name and location to allow the User to follow up on warranty issues and help with future purchases.

3.5.9 Key Control System

Key Control System. Provide system in excel format; indicate lock number, room number and location of lock within rooms if more than one lock number.

-- End of Section --

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# B-21: WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)
# ELLSWORTH AIR FORCE BASE, SD
## Furniture, Fixtures, & Equipment (FF&E) Binder

Project Number: FXBM223909

**Advertisement – 100% Design Issue**

**April 28th 2023**

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PROJECT: B-21: WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)
ELLSWORTH AIR FORCE BASE, SD
JACOBS PROJECT: FXBM223909

DESIGNER OF RECORD:
JACOBS
777 MAIN STREET, FORT WORTH, TX 76102
CONTACT: MACHELLE ABOVE

FURNITURE, FIXTURES & EQUIPMENT


| | |
|---|---|
| Design Analysis | Tab 1 |
| Point of Contact List | Tab 2 |
| Furniture Cost Estimate & Mfgr Source List | Tab 3 |
| Room Contents List | Tab 4 |
| FF&E Order Data Sheets | Tab 5 |
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| FF&E Plans & FF&E Typicals | Tab 8 |
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## Interior Design

### Design Criteria and References

The following criteria apply to the interior design for the project:

- Ellsworth Air Force Installation Facilities Standards (IFS).
- Architectural Barriers Act (ABA) Standards, 2015
- International Building Code IBC (2018)
- NFPA 101, Life Safety Code (2018)
- UFC 1-200-01, DoD Building Code (2019), with Change 1 (2020)
- UFC 1-200-02, High Performance and Sustainable Building Requirements (2020)
- UFC 3-120-01, Design: Sign Standards (2014), with Change 3 (2017)
- UFC 3-120-10, Interior Design (2018) Change 2 (2021)
- USACE Omaha District Design Guide (2019)
- Unified Facilities Guide Specifications (UFGS)

### Functional and Technical Requirements

#### General Description

Project to convert one quadrant of the existing Ellsworth AFB hangar located in B7504 (known as the PRIDE Hangar) into a Weapons Loading Trainer. The project will offer a continuation from the initial B1 Parts Storage area. The facility will need to accommodate warehouse and administrative space, including open office workstations and private offices, break, conference, and training.

#### Comprehensive Interior Design

The Comprehensive Interior Design (CID) package includes Structural Interior Design (SID), and Furniture, Fixtures, and Equipment (FF&E). The goal of the CID is to provide a functional, durable, visually appealing facility to enhance the user's working environment, increase morale, and instill a sense of pride. Criteria for finish and furniture selections include suitability of use, durability, aesthetic character, and sustainability. Finishes in the SID and FF&E package are coordinated to create a unified, cohesive facility in line with previously designed phases.

#### Furniture, Fixtures, and Equipment (FF&E) – Bid Option

FF&E will be a bid option to the contract, provided and installed by the contractor and is funded separately from the construction contract. FF&E will be specified as a basis of design for coordination with building construction and required infrastructure. FF&E includes systems furniture workstations, ergonomic seating,

standard filing and storage cabinets, dining tables and chairs in Break area, and waiting seats in the Lobby. Enclosed offices will include desks with returns and overhead storage, pedestal drawers, as well as task and guest seating. Open office workstations will include desks with return and overhead storage, pedestal drawers, and task seating. White boards, monitors, and all break room/wellness room appliances, with exception of full-size refrigerator, will be included in FF&E package

Finishes for FF&E in administrative areas include metal frame desks with plastic laminate work surfaces and painted metal storage units. Task seating will be adjustable and ergonomic. All FF&E finishes will be compatible with building finishes.

The basis of design FF&E will be specified from General Service Administration contracts wherever possible. Products will have recycled material and/or be Green Guard-certified where applicable to meet sustainable objectives.

**Government Furnished Equipment**

Government-furnished equipment provided by the end users includes but is not limited to storage shelving units, tool storage, shop/industrial equipment, freestanding copiers/printers/plotters, and full-size refrigerator.

# POINT OF CONTACT LIST

PROJECT: DESIGN B-21: WEAPONS LOADER
TRAINING FACILITY
ELLSWORTH AIR FORCE BASE, SD
JACOBS PROJECT: FXBM231802

**USACE, Omaha District**
Andy Temeyer
CENWO-PMM
1616 Capitol Avenue
Omaha, NE 68102-4901
andy.c.temeyer@usace.army.mil

**Ellsworth Air Force Base, SD**
EAFB B-21 PIO
1947 Scott Drive
Ellsworth AFB, SD 57706

**JACOBS**
Bryan Dyson, AIA
Project Manager
618-317-7295
Bryan.dyson@jacobs.com

**JACOBS**
Machelle Above, RID, LEED AP ID+C, WELL AP
Interior Designer
Jacobs
777 Main Street, B101
Fort Worth, TX 76102
214-681-7889
Machelle.above@jacobs.com

# FF&E COST ESTIMATE

**COST ESTIMATE**

PROJECT: B-21: WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)
ELLSWORTH AIR FORCE BASE, SD

| ITEM | DESCRIPTION | QTY | COST | COST EXT |
|---|---|---|---|---|
| AP1 | UNDERCOUNTER REFRIGERATOR | 1 | $600.00 | $600.00 |
| AP2 | MICROWAVE | 3 | $400.00 | $1,200.00 |
| AP3 | REFRIGERATOR | 1 | $1,000.00 | $1,000.00 |
| AP4 | COFFEE MAKER | 1 | $200.00 | $200.00 |
| CH1 | CHAIR, TASK | 26 | $741.00 | $19,266.00 |
| CH2 | CHAIR, DINING | 14 | $154.00 | $2,156.00 |
| CH3 | CHAIR, GUEST | 4 | $618.00 | $2,472.00 |
| CH4 | CHAIR, RECLINER | 1 | $3,917.00 | $3,917.00 |
| CH5 | CHAIR, WAITING | 3 | $222.00 | $666.00 |
| CH6 | CHAIR, TRAINING | 38 | $412.05 | $15,657.90 |
| CH7 | CHAIR, CONFERENCE | 10 | $1,300.64 | $13,006.36 |
| CL1 | WALL CLOCK | 10 | $91.00 | $910.00 |
| D1 | DESK, L-SHAPED | 2 | $4,500.00 | $9,000.00 |
| DB1 | DISPLAY BOARD, GLASS FRONT | 1 | $350.00 | $350.00 |
| L1 | LECTERN | 1 | $4,025.00 | $4,025.00 |
| MA1 | TRASH/RECYCLING RECEPTACLE | 2 | $100.00 | $200.00 |
| MA2 | RECYCLE BIN (DESKSIDE) | 33 | $7.00 | $231.00 |
| MA3 | TRASH BIN (DESKSIDE) | 35 | $7.00 | $245.00 |
| MA4 | TELEVISON | 2 | $1,199.99 | $2,399.98 |
| MB1 | MARKERBOARD | 5 | $475.00 | $2,375.00 |
| MB2 | MARKERBOARD 96" | 4 | $600.00 | $2,400.00 |
| ST1 | STORAGE, 2-DOOR CABINET | 3 | $367.00 | $1,101.00 |
| ST2 | STORAGE, 4-DRAWER LATERAL FILE | 11 | $676.00 | $7,436.00 |
| ST3 | SHELVING, HEAVY DUTY | 39 | $1,500.00 | $58,500.00 |
| T1 | TABLE, DINING | 4 | $169.00 | $676.00 |
| T2 | TABLE, OCCASIONAL | 1 | $892.00 | $892.00 |
| T3 | TABLE, SIDE | 1 | $201.00 | $201.00 |
| T4 | TABLE, TRAINING | 17 | $1,932.00 | $32,844.00 |
| T5 | TABLE, CONFERENCE | 1 | $6,171.16 | $6,171.16 |
| T6 | TABLE, CONFERENCE SMALL | 1 | $3,540.19 | $3,540.19 |
| WS1 | WORKSTATION - 6x6 | 17 | $3,000.00 | $51,000.00 |
| WS2 | WORKSTATION - 8x8 | 5 | $4,000.00 | $20,000.00 |
| WS3 | WORKSTATION - 5x6 | 6 | $2,500.00 | $15,000.00 |
| | | | | |
| **FF&E SUBTOTAL** | | | | $279,638.58 |
| | | | | |
| **ESTIMATED FREIGHT (10%)** | | | | $27,963.86 |
| **ESTIMATED INSTALLATION (10%)** | | | | $27,963.86 |
| **CONTINGENCY (10%)** | | | | $27,963.86 |
| **ESCALATION (2 YEARS - 4% PER YEAR)** | | | | $22,371.09 |
| | | | | |
| **TOTAL PROJECT FF&E COST ESTIMATE** | | | | $385,901.24 |

*SELECTIONS PROVIDED FROM GSA SCHEDULE WHERE AVAILABLE
**WORKSTATIONS INCLUDE PANELS & WORKSTATION COMPONENTS
***ABOVE NUMBERS ARE ESTIMATES

# ITEM CODE INDEX

**ITEM CODE INDEX**

PROJECT: PROJECT: B-21: WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)
ELLSWORTH AIR FORCE BASE, SD
PROJECT NUMBER: FXBM231802

| ITEM CODE | DESCRIPTION | MANUFACTURER |
|---|---|---|
| | | |
| AP1 | REFRIGERATOR, UNDERCOUNTER | ACCUCOLD |
| AP2 | MICROWAVE | GE APPLIANCES |
| AP3 | REFRIGERATOR | GE APPLIANCES |
| AP4 | COFFEE MAKER | BUNN |
| CH1 | CHAIR, TASK | HERMAN MILLER |
| CH2 | CHAIR, DINING | HERMAN MILLER |
| CH3 | CHAIR, GUEST | HERMAN MILLER |
| CH4 | CHAIR, RECLINER | HERMAN MILLER |
| CH5 | CHAIR, WAITING | HERMAN MILLER |
| CH6 | CHAIR, TRAINING | HERMAN MILLER |
| CH7 | CHAIR, CONFERENCE | HERMAN MILLER |
| CL1 | WALL CLOCK | HOWARD MILLER |
| D1 | DESK, L-SHAPED | HERMAN MILLER |
| DB1 | DISPLAY BOARD, GLASS FRONT | GLOBAL INDUSTRIAL |
| L1 | LECTERN | ENWORK |
| MA1 | TRASH/RECYCLING RECEPTACLE | ULINE |
| MA2 | RECYCLE BIN (DESKSIDE) | ULINE |
| MA3 | TRASH BIN (DESKSIDE) | ULINE |
| MA4 | TELEVISION | SAMSUNG |
| MB1 | MARKERBOARD | ULINE |
| MB2 | MARKERBOARD 96" | ULINE |
| ST1 | STORAGE, 2-DOOR CABINET | HERMAN MILLER |
| ST2 | STORAGE, 4-DRAWER LATERAL FILE | HERMAN MILLER |
| ST3 | SHELVING, HEAVY DUTY | RAPISTAK |
| T1 | TABLE, DINING | HERMAN MILLER |
| T2 | TABLE, OCCASIONAL | HERMAN MILLER |
| T3 | TABLE, SIDE | HERMAN MILLER |
| T4 | TABLE, TRAINING | HERMAN MILLER |
| T5 | TABLE, CONFERENCE | HERMAN MILLER |
| T6 | TABLE, CONFERENCE, SMALL | HERMAN MILLER |
| WS1 | WORKSTATION - 6 X 6 | HERMAN MILLER |
| WS2 | WORKSTATION - 8 X 8 | HERMAN MILLER |
| WS3 | WORKSTATION - 5 X 6 | HERMAN MILLER |
| | | |
| | | |

# ROOM CONTENTS LIST

PROJECT B-21: WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)
ELLSWORTH AIR FORCE BASE, SD
PROJECT NUMBER: FXBM231802

| ROOM | ITEM CODE | DESCRIPTION | QTY |
|---|---|---|---|
| **1001** | | | |
| **LOBBY** | | | |
| | CH5 | CHAIR, WAITING | 3 |
| | T3 | TABLE, SIDE - 24" SQUARE | 1 |
| **1004** | | | |
| **MOTHERS** | | | |
| | CH4 | CHAIR, RECLINER | 1 |
| | CL1 | WALL CLOCK | 1 |
| | T2 | TABLE, OCCASIONAL - 20" ROUND | 1 |
| | MA2 | RECYCLING BIN (DESK SIDE) | 1 |
| | MA3 | TRASH BIN (DESK SIDE) | 1 |
| | AP1 | UNDERCOUNTER REFRIGERATOR | 1 |
| | AP2 | MICROWAVE | 1 |
| **1010** | | | |
| **WING MGR** | | | |
| | CH1 | CHAIR, TASK | 1 |
| | CH3 | CHAIR, GUEST | 2 |
| | CL1 | WALL CLOCK | 1 |
| | D1 | DESK, L-SHAPED | 1 |
| | MA2 | RECYCLING BIN (DESK SIDE) | 1 |
| | MA3 | TRASH BIN (DESK SIDE) | 1 |
| **1011** | | | |
| **CONFERENCE** | | | |
| | CH7 | CHAIR, TASK | 10 |
| | T5 | TABLE, CONFERENCE | 1 |
| | CL1 | WALL CLOCK | 1 |
| | MB2 | MARKERBOARD 96" | 4 |
| | MA2 | RECYCLING BIN (DESK SIDE) | 1 |
| | MA3 | TRASH BIN (DESK SIDE) | 1 |
| | MA4 | TELEVISION | 1 |
| **1012** | | | |
| **TRAINING** | | | |
| | CH6 | CHAIR, TRAINING | 30 |
| | CL1 | WALL CLOCK | 1 |
| | L1 | LECTERN | 1 |
| | MB1 | MARKERBOARD | 2 |
| | MA2 | RECYCLING BIN (DESK SIDE) | 1 |
| | MA3 | TRASH BIN (DESK SIDE) | 1 |
| | MA4 | TELEVISION | 1 |
| | T4 | TABLE, TRAINING | 15 |

# ROOM CONTENTS LIST

**1021**
**LSC SUITE**

| | | |
|---|---|---|
| CH1 | CHAIR, TASK | 5 |
| CL1 | WALL CLOCK | 1 |
| MA2 | RECYCLE BIN (DESK SIDE & COPIER) | 6 |
| MA3 | TRASH BIN (DESK SIDE) | 5 |
| ST1 | STORAGE, 2-DOOR CABINET | 1 |
| ST2 | STORAGE, 4-DRAWER LATERAL FILE | 2 |
| WS2 | WORKSTATION - 8 X 8 | 5 |
| MB1 | MARKERBOARD | 1 |

**1022**
**WS SUPER**

| | | |
|---|---|---|
| CH1 | CHAIR, TASK | 1 |
| CH3 | CHAIR, GUEST | 2 |
| CL1 | WALL CLOCK | 1 |
| D1 | DESK, L-SHAPED | 1 |
| MA2 | RECYCLING BIN (DESK SIDE) | 1 |
| MA3 | TRASH BIN (DESK SIDE) | 1 |
| MB1 | MARKERBOARD | 1 |

**1023**
**SLC SUITE**

| | | |
|---|---|---|
| CH1 | CHAIR, TASK | 11 |
| CL1 | WALL CLOCK | 1 |
| MA2 | RECYCLE BIN (DESK SIDE & COPIER) | 12 |
| MA3 | TRASH BIN (DESK SIDE) | 11 |
| ST1 | STORAGE, 2-DOOR CABINET | 1 |
| ST2 | STORAGE, 4-DRAWER LATERAL FILE | 9 |
| WS1 | WORKSTATION - 6 X 6 | 11 |
| MB1 | MARKERBOARD | 1 |

**1025**
**BREAK**

| | | |
|---|---|---|
| CH2 | CHAIR, DINING | 14 |
| CL1 | WALL CLOCK | 1 |
| DB1 | DISPLAY BOARD, GLASS FRONT | 1 |
| MA1 | TRASH/RECYCLING RECEPTACLE | 2 |
| MA4 | TELEVISION | 1 |
| T1 | TABLE, DINING | 4 |
| AP2 | MICROWAVE | 2 |
| AP3 | REFRIGERATOR | 1 |
| AP4 | COFFEE POT | 1 |

## ROOM CONTENTS LIST

**1031**
**CONTRACTOR SUPPORT**

| | | |
|---|---|---|
| CH1 | CHAIR, TASK | 6 |
| CL1 | WALL CLOCK | 1 |
| MA2 | RECYCLE BIN (DESK SIDE & COPIER) | 6 |
| MA3 | TRASH BIN (DESK SIDE) | 6 |
| WS3 | WORKSTATION - 5 X 6 | 6 |

**1040**
**SMALL WLT**

| | | |
|---|---|---|
| CH6 | CHAIR, TRAINING | 8 |
| CL1 | WALL CLOCK | 1 |
| MA2 | RECYCLE BIN (DESK SIDE & COPIER) | 2 |
| MA3 | TRASH BIN (DESK SIDE) | 2 |
| ST1 | STORAGE, 2-DOOR CABINET | 1 |
| T4 | TABLE, TRAINING | 2 |
| TB | TABLE, CONFERENCE, SMALL | 1 |

**1045**
**WEAPONS LOADING TRAINER #1**

| | | |
|---|---|---|
| ST3 | SHELVING, HEAVY DUTY | 23 |

**1046**
**WEAPONS LOADING TRAINER #2**

| | | |
|---|---|---|
| ST3 | SHELVING, HEAVY DUTY | 16 |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **UNDERCOUNTER REFRIGERATOR** | | | **AP1** |
| **Manufacturer** | | | |
| **Name** | Accucold | **FSG** | |
| **Address** | 770 Garrison Ave • Bronx, NY 10474 | **SIN** | |
| **Telephone Number** | 855 204 5313 | **GSA Contract No.** | |
| **Email / Website** | www.accucold.com | **Expiration Date** | |
| **Item Description** | | | |
| **Manufacturer** | Accucold | | |
| **Product Name** | Undercounter Refrigerator | | |
| **Product Number** | CT663BKBIADA | | |
| **Dimensions** | 23.625"W x 23.5"D x 32.25"H | | |
| **Description** | ADA compliant undercounter refrigerator<br>3 adjustable shelves<br>Freezer compartment<br>Crisper<br>Stainless Steel finish<br>5.1 Cubic Foot capacity<br>Automatic defrost | | |
| **Finishes** | Finish: Stainless | | |
| **General Notes** | 1. Provide room number on carton.<br>2. Contractor must remove all packaging and clean area after installation. | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1004 | MOTHERS ROOM | 1 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **MICROWAVE** | | | **AP2** |
| **Manufacturer** | | | |
| **Name** | GE Appliances | **FSG** | |
| **Address** | P.O. Box 1780, Rapid City, SD 57707 | **SIN** | |
| **Telephone Number** | 800 626 2005 | **GSA Contract No.** | |
| **Email / Website** | www.GEAPPLIANCES.com | **Expiration Date** | |
| **Item Description** | | | |
| **Manufacturer** | GE Appliances | | |
| **Product Name** | Profile 1.5 Cu Ft. Countertop Convection / Microwave Oven | | |
| **Product Number** | PEB9159SJSS | | |
| **Dimensions** | 21-3/4"W x 20"D x 13"H | | |
| **Description** | Countertop microwave (1.5 cu. Ft.) with 1,000-watt cooking power.<br>Electronic digital display, sensor cooking, and 10 power levels.<br>Recessed glass turntable (13 1/2" diameter).<br>ADA-compliant | | |
| **Finishes** | Finish: Stainless | | |
| **General Notes** | 1. Provide room number on carton.<br>2. Contractor must remove all packaging and clean area after installation. | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1025 | BREAKROOM | 1 |
| 1004 | MOTHERS ROOM | 1 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | **TOTAL** | **2** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **REFRIGERATOR** | | | **AP3** |
| **Manufacturer** | | | |
| **Name** | GE Appliances | FSC | |
| **Address** | PO Box 1780, Rapid City, SD 57709 | SIN | |
| **Telephone Number** | (800) 626-2005 | GSA Contract No. | |
| **Email / Website** | www.geappliances.com | Expiration Date | |
| **Item Description** | | | |
| **Manufacturer** | FRIGIDAIRE | | |
| **Product Name** | 20.4 Cu Ft Top Freezer | | |
| **Product Number** | LFTR2021TF | | |
| **Dimensions** | 33"W x 34.5"D x 66.75"H | | |
| **Description** | Freestanding refrigerator with top freezer.<br>Energy Star Certified.<br>Spill safe shelves.<br>Adjustable door bins.<br>Humidity controlled crisper drawers.<br>Frost free automatic defrost freezer.<br>Reversible doors.<br>20.4 cu ft<br>Fingerprint Resistant Stainless Steel | | |
| **Finishes** | Finish: Stainless | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1025 | BREAKROOM | 1 |
| | | |
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| | | |
| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **COFFEE POT** | | | **AP4** |
| **Manufacturer** | | | |
| **Name** | Bunn | **FSG** | |
| **Address** | 5020 Ash Grove Dr., Springfield, IL 62711 | **SIN** | |
| **Telephone Number** | 800 626 2866 | **GSA Contract No.** | |
| **Email / Website** | (www.commercial.bunn.com) | **Expiration Date** | |
| **Item Description** | | | |
| **Manufacturer** | Bunn | | |
| **Product Name** | Dual Voltage Thermal Carafe Automatic Coffee Brewer | | |
| **Product Number** | 23001.0069 | | |
| **Dimensions** | 9"W x 21.5"D x 18.4"H | | |
| **Description** | Automatic coffee brewer with pourover feature.<br>Dual Voltage adaptable<br>Include (2) 8.5" thermal carafes (ordered separately)<br>Pourover feature, does not require plumbing | | |
| **Finishes** | Finish: Stainless | | |
| **General Notes** | 1. Provide room number on carton.<br>2. Contractor must remove all packaging and clean area after installation. | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1025 | BREAKROOM | 1 |
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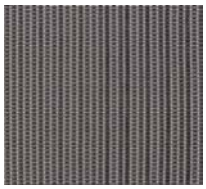
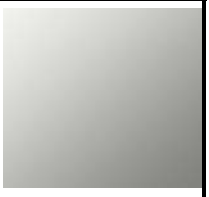
| | | |
| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM(TBD)
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **CHAIR, TASK** | | | **CH1** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Aeron | | |
| **Product Number** | AER1B23DWALPG1G1CDDC1BK23103 | | |
| **Dimensions** | 26 3/4" W x 26.3/4" D x 36 3/4" - 43 1/8" H | | |
| **Description** | Size B Ergonomic Task Chair<br>Suspension seat and back.<br>Adjustable Posturefit SL lumbar support.<br>5 Star Caster Base.<br>Multi-Surface caster with quiet roll<br>Fully adjustable arm pad in Black.<br>Standard Height range.<br>Tilt Limiter & Seat Angle<br>Adjustable seat depth.<br>350lb Weight Capacity. | | |
| **Finishes** | Seat/Back: 8Z Pellicle, Graphite 23103<br>Base/Frame: Polished Aluminum CD |   | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1010 | WING MGR | 1 |
| 1021 | LSC SUITE | 5 |
| 1022 | WS SUPER | 1 |
| 1023 | SLC SUITE | 11 |
| 1036 | CONTRACTOR SUPPORT | 6 |
| | | |
| | | |
| | | |
| | **TOTAL** | **24** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **CHAIR, DINING** | | | **CH2** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Caper Stack Chair | | |
| **Product Number** | WC410PMS3MYXSY | | |
| **Dimensions** | 20" W x 20.63" D x 29.63" OH, 24.75" AH | | |
| **Description** | Stacking Chair with Molded Seat & Fixed Arms<br>Floor Saver Glide Insert, Hard Floor Glide | | |
| **Finishes** | Seat and Back: Berry Blue, 3M<br>Frame: Metallic Silver, MS<br>Arms: Silver Grey, SY | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1025 | BREAK | 14 |
| | | |
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| | **TOTAL** | **14** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **CHAIR, GUEST** | | | **CH3** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Full Twist Guest Chair | | |
| **Product Number** | SFT1A1HA09G40133 | | |
| **Dimensions** | 23.5" W x 24" D x 30" H | | |
| **Description** | Solid wood guest chair with sculpted arms and back.<br>Ash wood frame/arms with upholstered seat.<br>Standard glides | | |
| **Finishes** | Seat Upholstery: Medley Feather Grey 1HA09<br>(100,000 double rubs Wyzenbeek method.)<br>Frame/Back: Dark Brown Walnut 40 | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1010 | WING MGR | 2 |
| 1022 | WS SUPER | 2 |
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| | **TOTAL** | **4** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **CHAIR, RECLINER** | | | **CH4** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Pamona Recliner | | |
| **Product Number** | 797-66FS1FW40MSSMBXMCY88S01 | | |
| **Dimensions** | 31.5" W x 33"-63.5" D x 44.5" H | | |
| **Description** | Recliner chair.<br>Solid maple frame<br>Mortise and tenon joinery<br>Spring seat construction<br>Replaceable components<br>Wood arm caps<br>Wallsaver edge<br>Powder-coated metal legs<br>1" (2.5cm) dia adjustable glides Push-back mechanism for footrest; finger-pull to recline<br>Infinite recline adjustment within a comfortable range<br>Moisture Barrier seat & back.<br>MicrobeCare Protection | | |
| **Finishes** | All Upholstery: Nimble 88S01 Palladium<br>(250,000 double rubs Wyzenbeek method.)<br>Dark Brown Walnut (40) Arm Caps<br>Metallic Silver Smooth Feet | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1004 | MOTHERS | 1 |
| | | |
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| | | |
| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **CHAIR, WAITING** | | | **CH5** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Verus Side Chair | | |
| **Product Number** | PIA4S1UPVPRSNAGL1MN133SL28 | | |
| **Dimensions** | 24.8"W x 23.5 "D x 32.9"H | | |
| **Description** | Guest chair with upholstered seat and back.<br>Fixed Arms<br>Frame: Mineral<br>Legs: Satin Aluminum<br>Angled wall saver legs<br>Polymer back shell and arms<br>Painted metal 4-leg base | | |
| **Finishes** | Back & Seat Upholstery: Sequel Navy 3SL28<br>( Wyzenbeek, 200,000 double rubs)<br>Polymer: Mineral<br>Legs: Satin Aluminum | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1001 | LOBBY | 3 |
| | | |
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| | **TOTAL** | **3** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM(TBD)
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **CHAIR, TRAINING** | | | **CH6** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Caper Stacking Chair | | |
| **Product Number** | WC420PMS63DSSY6V02 | | |
| **Dimensions** | 24.25" W 18.5" D 32" H | | |
| **Description** | Stacking Chair with FLEXNET Seat & Fixed Arms<br>Back is glass-filled nylon, contoured for comfort, flexible for give.<br>Hard Floor Locking Caster<br>Can stack 6-high on the floor or 15-high on the Caper Cart<br>Include (2) Caper Carts #WC904<br>300lb Weight Capacity | | |
| **Finishes** | Seat and Back: Flexnet Silver Grey, 3M<br>Frame: Metallic Silver, MS<br>Arms: Silver Grey, SY | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1012 | TRAINING ROOM | 30 |
| 1045 | SMALL WLT | 8 |
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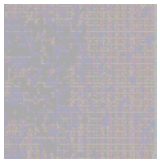
| | | |
| | **TOTAL** | **38** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM(TBD)
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **CHAIR, CONFERENCE** | | | **CH7** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Mirra 2 Chair | | |
| **Product Number** | MRF123AWAFAJMYWSC8SG8M21631A707 | | |
| **Dimensions** | 29" W 25" D 42" H | | |
| **Description** | Standard-Height Range<br>Tilt Limiter and Seat Angle<br>Fully Adjustable Arms<br>FlexFront Adjustable Seat Depth<br>Butterfly Suspension Back w/ Adjustable Lumbar Support<br>5 Star Base with 2 1/2" Caster, Hard Floors with Quiet Roll Technology<br>350lb Weight Capacity | | |
| **Finishes** | Base/Frame: Semi-Polished Base with Studio White Frame with MicrobeCare<br>Armpad: Fog<br>Back: Slate Grey<br>AirWeave: Dark Turquoise | |  |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1011 | CONFERENCE | 10 |
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| | **TOTAL** | **10** |

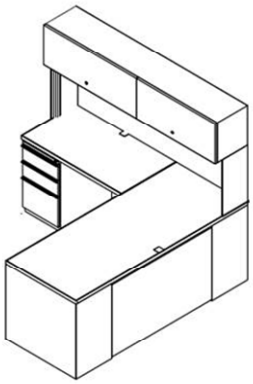
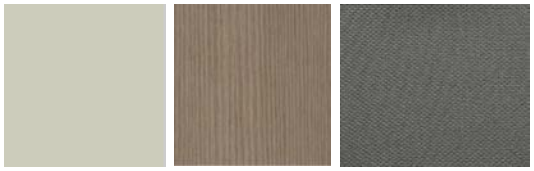
| Item | | | Item Code |
|---|---|---|---|
| **WALL CLOCK** | | | **CL1** |
| Manufacturer | | | |
| Name | Howard Miller | FSC | |
| Address | 860 East Main Avenue, Zeeland, MI 49464 | SIN | |
| Telephone Number | 616.772.9131 | GSA Contract No. | |
| Email / Website | www.howardmiller.com | Expiration Date | |
| Item Description | | | |
| Manufacturer | Howard Miller | | |
| Product Name | Easton Wall Clock | | |
| Product Number | 625-207 | | |
| Dimensions | 12" Dia. x 1-1/2"D | | |
| Description | White dial with bold black Arabic numerals and separate seconds track<br>Black hour, minute and second hands<br>Glass crystal face cover<br>Quartz, battery-operated movement powered by one AA battery<br>Include batteries when installed. | | |
| Finishes | Frame: Nickel<br>Dial: White | | |
| General Notes | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1004 | MOTHERS | 1 |
| 1010 | WING MGR | 1 |
| 1011 | CONFERENCE | 1 |
| 1012 | TRAINING | 1 |
| 1021 | LSC SUITE | 1 |
| 1022 | WS SUPER | 1 |
| 1023 | SLC SUITE | 1 |
| 1025 | BREAK | 1 |
| 1036 | CONTRACTOR SUPPORT | 1 |
| 1040 | SMALL WLT | 1 |
| | | |
| | | |
| | **TOTAL** | **10** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **DESK, L-SHAPED** | | | **D1** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Canvas Office | | |
| **Dimensions** | 66" W x 78" L x 66" H | | |
| **Description** | 66" x 30" desk with full height privacy panel. 48" x 24" return with partial height panel - ensure open access to wall power & data. Metal and laminate desk. Metal storage components with plastic laminate work surfaces. Include (1) box/box/file pedestal and (1) file/file pedestal.<br>All storage pieces to be lockable (All components in the same desk must be keyed alike).<br>Each section of worksurface must have (2) grommets with covers, minimum. Overhead flipper door storage and full height/full width tackboard on 78" return. Edge detail: Square/ Arc Pulls. LED task light under overhead storage.<br>Refer to FF&E plans for layout details. | |  |
| **Finishes** | Tackboard: Gem,Slate Grey, 9515<br>(Wyzenbeek, 120,000 double rubs)<br>Laminate Top/Front/Side Panels:<br>Phantom Cocoa, LBS<br>Metal Storage/Leg Finish: Sandstone, WL | |  |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1010 | WING MGR | 1 |
| 1022 | WS SUPER | 1 |
| | | |
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| | | |
| | **TOTAL** | **2** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **DISPLAY BOARD, GLASS FRONT** | | | **DB1** |
| Manufacturer | | | |
| Name | Global Industrial | FSC | |
| Address | 11 Harbor Park Drive, Port Washington, NY 110 | SIN | |
| Telephone Number | 800.607.8520 | GSA Contract No. | |
| Email / Website | www.globalindustrial.com | Expiration Date | |
| Item Description | | | |
| Manufacturer | Global Industrial | | |
| Product Name | Enclosed Cork Bulletin Board | | |
| Product Number | T9F695482 | | |
| Dimensions | 48" W x 36" H x 2" D | | |
| Description | 2" Thick Anodized Aluminum Frame<br>Self-Healing Cork Surface with particle board back<br>Full-Length Door Hinges - 180 degree swing<br>2.7mm Shatter Resistant Acrylic Windows<br>Lockable Doors with Keys<br>Hardware Included<br>1 year Warranty | | |
| Finishes | Frame: Anodized Aluminum<br>Back: Cork | | |
| General Notes | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1025 | BREAK | 1 |
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| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **LECTERN** | | | **L1** |
| Manufacturer (Basis of Design) | | | |
| Name | Enwork | FSC | |
| Address | 12900 Christopher Dr., Lowell, Michigan 49331 | SIN | |
| Telephone Number | 1.800.815.7251 | GSA Contract No. | |
| Email / Website | https://www.enwork.com | Expiration Date | |
| Item Description | | | |
| Manufacturer | Enwork | | |
| Product Name | Ligouri Lectern | | |
| Dimensions | 24"D x 28"W x 46"H | | |
| Description | Two door cabinet with hidden casters behind black recessed skirt.<br>Includes pull out shelf with touch latch (17.5"D x 18.5"W) on side of lecturn and adjustable shelf inside cabinet.<br>Pull Out Shelf<br>Pencil Ledge<br>Privacy Panel | | |
| Finishes | Finish: Fawn Cypress | | |
| General Notes | | | |

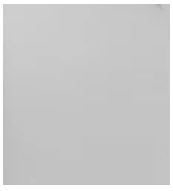
**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1012 | TRAINING ROOM | 1 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **TRASH/RECYCLING RECEPTACLE** | | | **MA1** |
| Manufacturer (Basis of Design) | | | |
| Name | ULINE | FSC | 8744 |
| Address | 12575 Uline Drive, Pleasant Prairie, WI 53158 | SIN | |
| Telephone Number | (800) 295.5510 | GSA Contract No. | HS-21F-0147V |
| Email / Website | https://www.uline.com/ | Expiration Date | 15-Sep-2024 |
| Item Description | | | |
| Manufacturer | ULINE | | |
| Product Name | Rubbermaid Slim Jim Trash Can | | |
| Product Number | H-2893GR | | |
| Dimensions | 22 x 11 x 25" | | |
| Description | 16 Gallon Trash Can<br>Heavy-duty plastic construction resists denting, bending and cracking.<br>Handle deisgn holds liners securely.<br>Vented side challens for easy liner removal. | | |
| Finishes | Finish: Gray | | |
| General Notes | | | |



**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1025 | BREAK | 2 |
| | | |
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| | | |
| | | |
| | **TOTAL** | **2** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **RECYCLE BIN (DESKSIDE)** | | | **MA2** |
| Manufacturer (Basis of Design) | | | |
| Name | ULINE | FSC | 8744 |
| Address | 12575 Uline Drive, Pleasant Prairie, WI 53158 | SIN | |
| Telephone Number | 800.295.5510 | GSA Contract No. | HS-21F-0147V |
| Email / Website | www.uline.com | Expiration Date | 15-Sep-2024 |
| Item Description | | | |
| Manufacturer | ULINE (Rubbermaid) | | |
| Product Name | Office Recycling Container - 7 Gallon | | |
| Product Number | H-1384BLU | | |
| Dimensions | 10"W x 14"D x 15"H | | |
| Description | 7 gallon capacity waste receptacle.<br>Plastic construction with rolled rim.<br>Dent, rust, and chip resistant.<br>***Note: Include one (1) per every desk, D1 and workstation,WS1-WS2. Include one (1) per copier location.** | | |
| Finishes | Blue | | |
| General Notes | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1010 | WING MGR | 1 |
| 1021 | LSC SUITE | 6 |
| 1022 | WS SUPER | 1 |
| 1023 | SLC SUITE | 12 |
| 1036 | CONTRACTOR SUPPORT | 7 |
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| | | |
| | **TOTAL** | **27** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **TRASH BIN (DESKSIDE)** | | | **MA3** |
| Manufacturer (Basis of Design) | | | |
| Name | ULINE | FSC | 8744 |
| Address | 12575 Uline Drive, Pleasant Prairie, WI 53158 | SIN | |
| Telephone Number | 800.295.5510 | GSA Contract No. | HS-21F-0147V |
| Email / Website | www.uline.com | Expiration Date | 15-Sep-2024 |
| Item Description | | | |
| Manufacturer | ULINE (Rubbermaid) | | |
| Product Name | Office Trash Can - 7 Gallon | | |
| Product Number | S-9970GR | | |
| Dimensions | 10"W x 14"D x 15"H | | |
| Description | 7 gallon capacity waste receptacle.<br>Plastic construction with rolled rim.<br>Dent, rust, and chip resistant.<br>***Note: Include one per every room and desk, D1 and workstation,WS1-WS3.** | | |
| Finishes | Gray | | |
| General Notes | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1003 | RESTROOM | 1 |
| 1004 | MOTHERS ROOM | 1 |
| 1010 | WING MGR | 1 |
| 1011 | CONFERENCE | 1 |
| 1012 | TRAINING ROOM | 1 |
| 1021 | LSC SUITE | 5 |
| 1022 | WS SUPER | 1 |
| 1023 | SLC SUITE | 11 |
| 1025 | BREAK ROOM | 1 |
| 1027 | MEN | 1 |
| 1028 | WOMEN | 1 |
| 1031 | CONTRACTOR SUPPORT | 6 |
| 1040 | SMALL WLT | 2 |
| 1045 | WEAPONS LOADING TRAINER #1 | 2 |
| | | |
| | | |
| | **TOTAL** | **35** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **TELEVISION** | | | **MA4** |
| Manufacturer (Basis of Design) | | | |
| Name | SAMSUNG | FSC | |
| Address | | SIN | |
| Telephone Number | 300.362.603 | GSA Contract No. | |
| Email / Website | https://www.samsung.com | Expiration Date | |
| Item Description | | | |
| Manufacturer | SAMSUNG | | |
| Product Name | SAMSUNG 7 SERIES | | |
| Product Number | AU8000 | | |
| Dimensions | 65" MONITOR | | |
| Description | 65" DIAGONAL DISPLAY LED MONITOR. 4K PROCESSOR WITH 4K ULTRA HD, 2160p RESOLUTION, CYRSTAL DISPLAY, ULTRA-THIN BEZEL ON ALL SIDES, SMART TV WITH UNIVERSAL GUIDE. (2) HDMI 2.0, (1) USB PORT, (2) USB 2.0 PORTS, ETHERNET, AND RF ANTENNA, INPUTS, BLUETOOTH AND WIFI ENABLED. STAND INCLUDED. | | |
| Finishes | STANDARD | | |
| General Notes | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1011 | CONFERENCE | 1 |
| 1025 | BREAK ROOM | 1 |
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| | **TOTAL** | **2** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **MARKERBOARD** | | | **MB1** |
| Manufacturer | | | |
| Name | ULINE | FSC | 8744 |
| Address | 12575 Uline Drive, Pleasant Prairie, WI 53158 | SIN | |
| Telephone Number | 800.295.5510 | GSA Contract No. | HS-21F-0147V |
| Email / Website | www.uline.com | Expiration Date | 15-Sep-2024 |
| Item Description | | | |
| Manufacturer | ULINE | | |
| Product Name | Glass Dry Erase Boards | | |
| Product Number | H-7181 | | |
| Dimensions | 72" W x 48" H | | |
| Description | Tempered Glass will not ghost or stain. Doubles as a magnetic bulletin board. Includes four rare earth magents. White - Includes 4 markers, tray and mounting hardware. | | |
| Finishes | White tempered glass | | |
| General Notes | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1012 | TRAINING ROOM | 2 |
| 1021 | LSC SUITE | 1 |
| 1022 | WS SUPER | 1 |
| 1023 | SLC SUITE | 1 |
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| | **TOTAL** | **5** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **MARKERBOARD 96"** | | | **MB2** |
| Manufacturer | | | |
| Name | ULINE | FSC | 8744 |
| Address | 12575 Uline Drive, Pleasant Prairie, WI 53158 | SIN | |
| Telephone Number | 800.295.5510 | GSA Contract No. | HS-21F-0147V |
| Email / Website | www.uline.com | Expiration Date | 15-Sep-2024 |
| Item Description | | | |
| Manufacturer | ULINE | | |
| Product Name | Glass Dry Erase Boards | | |
| Product Number | H-7805 | | |
| Dimensions | 96" W x 48" H | | |
| Description | Tempered Glass will not ghost or stain. Doubles as a magnetic bulletin board. Includes four rare earth magents. White - Includes 4 markers, tray and mounting hardware. | | |
| Finishes | White tempered glass | | |
| General Notes | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1011 | CONFERENCE ROOM | 4 |
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| | **TOTAL** | **4** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **STORAGE, 2-DOOR CABINET** | | | **ST1** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Meridian - Standard Pull Storage | | |
| **Product Number** | 46-361829SSWLNS1KATLLBSLBSB4 | | |
| **Dimensions** | 36" W x 18" D x 30 3/4" H | | |
| **Description** | Two door cabinet, with one shelf.<br>Hinged doors open to 110 degrees.<br>All storage pieces to be lockable (All components in the same office must be keyed alike).<br>1 1/4"H Laminate top with Thermoplastic edge. 3 1/4"H Base with adjustable glides | | |
| **Finishes** | Metal: Sandstone WL<br>Wood laminate Doors and Top: Phantom Cocoa, LBS | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1021 | LSC SUITE | 1 |
| 1023 | SLC SUITE | 1 |
| 1040 | SMALL WLT | 1 |
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| | **TOTAL** | **3** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **STORAGE, 4-DRAWER LATERAL FILE** | | | **ST2** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Meridian Bar-Pull Freestanding Lateral File | | |
| **Product Number** | 2KP36184NSSWLT1KAWLB4CB9R | | |
| **Dimensions** | 36"W x 18" D x 51 1/4" H | | |
| **Description** | 4-Drawer Freestanding Lateral File<br>Smooth Steel - Painted Surfaces<br>1" H Painted Metal Top with Squared Edge<br>Locking - Keyed Alike<br>3 1/4"H Base<br>Counterweight<br>Side to Side Filing Rail | | |
| **Finishes** | Metal: Sandstone WL<br>Pull Finish: Sandstone WL | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1021 | LSC SUITE | 5 |
| 1023 | SLC SUITE | 9 |
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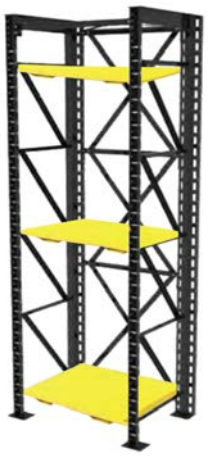
| | **TOTAL** | **14** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **SHELVING, HEAVY DUTY** | | | **ST3** |
| **Manufacturer** | | | |
| **Name** | RAPISTAK | FSC | |
| **Address** | 1 Alliance Dr., Buffalo, NY 14218 | SIN | |
| **Telephone Number** | 716-822-2804 | GSA Contract No. | |
| **Email / Website** | www.rapistak.com | Expiration Date | |
| **Item Description** | | | |
| **Manufacturer** | RAPISTAK | | |
| **Product Name** | MAX-RAK IAR 246 | | |
| **Product Number** | By Vendor | | |
| **Dimensions** | 48"W x 24"D x 9'-0"H | | |
| **Description** | Adjustable Rack Storage Management System<br>Standard 48"W x 24"D Pallets<br>Pallets Equipped with Full Length Fork Pockets<br>3 Pallets at 4", 40" and 96"H<br>2,000 lb. Weight Capacity (25,000 lbs. per section) | | |
| **Finishes** | | | |
| **General Notes** | | | |



**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1045 | WEAPONS LOADING TRAINER #1 | 23 |
| 1046 | WEAPONS LOADING TRAINER #2 | 16 |
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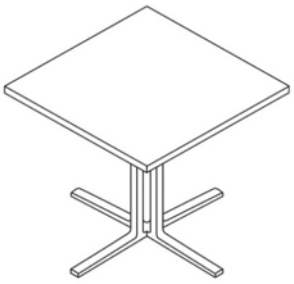
| | **TOTAL** | **39** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **TABLE, DINING** | | | **T1** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Everywhere Table | | |
| **Product Number** | DT1BS.3030LXLBSWLG257 | | |
| **Dimensions** | 30" W 30" L x 28.5" H | | |
| **Description** | Square dining table with laminate top and matching square thermoplastic edge.<br>4-column painted metal base on 1/2" leveling glides<br>Edging: Laminate | |  |
| **Finishes** | Base: Sandstone, WL<br>Laminate Top: Phantom Cocoa, LBS | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1025 | BREAK | 4 |
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| | **TOTAL** | **4** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **TABLE, OCCASIONAL** | | | **T2** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Striad Pedestal Side Table | | |
| **Product Number** | CCL5002124LNGWNPA | | |
| **Dimensions** | 24" Dia. x 21.5" H | | |
| **Description** | Round laminate table knife profile edge. Base is aluminum with adjustable glides. No Grommet. | | |
| **Finishes** | Base: Polished Aluminum, PA<br>Laminate Top: Warm Grey Neutral, WN | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1004 | MOTHERS | 1 |
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| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **TABLE, SIDE** | | | **T3** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |

| **Item Description** | |
|---|---|
| **Manufacturer** | Herman Miller |
| **Product Name** | Occasional Table, Square |
| **Product Number** | DT4BS2424LSLBCLBCBK |
| **Dimensions** | 24" W x 24" D x 16" H |
| **Description** | Square Occasional Table with Laminate Top and matching Thermoplastic Edge<br>Painted metal base with 1/2" Leveling Glides |

| | | |
|---|---|---|
| **Finishes** | Base: Sandstone, WL<br>Laminate Top: Phantom Cocoa, LBS | |
| **General Notes** | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1001 | LOBBY | 1 |
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| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM(TBD)
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **TABLE, TRAINING** | | | **T4** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Everywhere Table - Flip-Top | | |
| **Product Number** | DT5AS | | |
| **Dimensions** | 24"W x 60"L x 28 1/2"H | | |
| **Description** | Rectangular training table with squared edge laminate top and matching thermoplastic edge.<br>Flip-Top table top with T-Leg Base.<br>4-column painted metal base on locking casters.<br><br>Tables will daisy chain to adjacent wall outlet.<br>SAFCO #MRPM3BLK Power module with daisy chain should be located 3" from the rear edge and centered on table top. 2 simplex receptacles with 2 powered USB outlets. USB ports provide a combined 20 watts of power to charge most devices and tablets at full speed. | | |
| **Finishes** | Base: Sandstone, WL<br>Laminate Top: Phantom Cocoa, LBS | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1024 | Training Room | 15 |
| 1027 | Small WLT | 2 |
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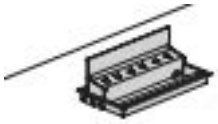
| | **TOTAL** | **17** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **TABLE, CONFERENCE** | | | **T5** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Headway Table | | |
| **Product Number** | DP1BYT2842144LN | | |
| **Dimensions** | 144" W x 42" D x 42" H | | |
| **Description** | Boat conference table with laminate top and painted Y-base.<br>Squared thermoplastic edge<br>1 1/2" leveling glides<br><br>Include (2) Logic G1000 Grommet mounted electrical distributor Y1425IA06G1 with 4 simplex receptacles, 1 powered USB A/C Combo with 6' power cord with plug end. Finish Graphite (G1) | | <br>  <br> |
| **Finishes** | Base: Sandstone, WL<br>Laminate Top: Phantom Cocoa, LBS | | |
| **General Notes** | | | |

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1011 | CONFERENCE | 1 |
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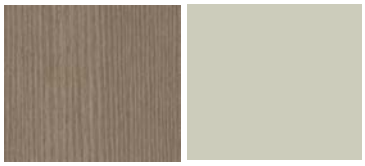
| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **TABLE, CONFERENCE SMALL** | | | **T6** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Headway Table | | |
| **Product Number** | DP1BYT284272LN | | |
| **Dimensions** | 72" W x 42" D x 42" H | | |
| **Description** | Boat conference table with laminate top and painted Y-base. | | |
| **Finishes** | Base: Sandstone, WL<br>Laminate Top: Phantom Cocoa, LBS | | |
| **General Notes** | | | |



**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1027 | SMALL WLT | 1 |
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| | **TOTAL** | **1** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **WORKSTATION - 6 x 6** | | | **WS1** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Canvas Office | | |
| **Product Number** | By Vendor | | |
| **Dimensions** | 72" OW x 72" OL x 66" H | | |
| **Description** | Panel fabric with painted metal top and end caps.<br>Frame attached worksurfaces and overhead flipper door storage mounted to 66" high panel only. LED task light under overhead storage. 2+2 Power System in base raceway.<br>Include 2 power receptacles/1 data/USB per panel (2 sets per WS) | | |
| **Finishes** | Panel Fabric: Gem,Slate Grey, 9515<br>(Wyzenbeek, 120,000 double rubs)<br>Panel Trim/Base Paint: Sandstone, WL<br>Worksurface Top/Edge Finish: Phantom Cocoa, LBS<br>Metal/ Overhead Storage Finish: Sandstone, WL | | |
| **General Notes** | | | |

**CONCEPT ONLY**

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1023 | SLC SUITE | 11 |
| 1035 | CONTRACTOR SUPPORT | 6 |
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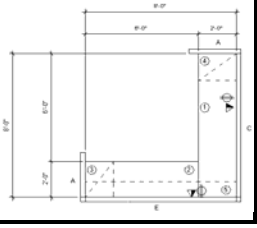
| | **TOTAL** | **17** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **WORKSTATION - 8X8** | | | **WS2** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Canvas Office | | |
| **Product Number** | By Vendor | | |
| **Dimensions** | 96" OW x 96" OL x 66" H | | |
| **Description** | Panel fabric with painted metal top and end caps.<br>Frame attached worksurfaces and overhead flipper door storage mounted to 66" high panel only. LED task light under overhead storage. 2+2 Power System in base raceway.<br>Include 2 power receptacles/1 data/USB per panel (2 sets per WS) | | |
| **Finishes** | Panel Fabric: Gem,Slate Grey, 9515<br>(Wyzenbeek, 120,000 double rubs)<br>Panel Trim/Base Paint: Sandstone, WL<br>Worksurface Top/Edge Finish: Phantom Cocoa, LBS<br>Metal/ Overhead Storage Finish: Sandstone, WL | | |
| **General Notes** | | | |



**CONCEPT ONLY**

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1021 | LSC SUITE | 5 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | **TOTAL** | **5** |

# FF&E ORDER DATA SHEET

PROJECT: FXBM231802
ELLSWORTH AFB, SD
B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)

| Item | | | Item Code |
|---|---|---|---|
| **WORKSTATION - 5X6** | | | **WS3** |
| **Manufacturer** | | | |
| **Name** | Herman Miller | FSC | 71, Part 1 |
| **Address** | 855 East Main Ave., Zeeland, MI 49464 | SIN | 33721 |
| **Telephone Number** | (888) 443 - 4357 | GSA Contract No. | GS-03F-036DA |
| **Email / Website** | www.hermanmiller.com | Expiration Date | 20-Dec-2025 |
| **Item Description** | | | |
| **Manufacturer** | Herman Miller | | |
| **Product Name** | Canvas Office | | |
| **Product Number** | By Vendor | | |
| **Dimensions** | 60" OW x 72" OL x 66" H | | |
| **Description** | Panel fabric with painted metal top and end caps.<br>Frame attached worksurfaces and overhead flipper door storage mounted to 66" high panel only. LED task light under overhead storage. 2+2 Power System in base raceway.<br>Include 2 power receptacles/1 data/USB per panel (2 sets per WS) | | |
| **Finishes** | Panel Fabric: Gem,Slate Grey, 9515<br>(Wyzenbeek, 120,000 double rubs)<br>Panel Trim/Base Paint: Sandstone, WL<br>Worksurface Top/Edge Finish: Phantom Cocoa, LBS<br>Metal/ Overhead Storage Finish: Sandstone, WL | | |
| **General Notes** | | | |

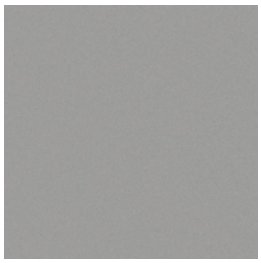
**CONCEPT ONLY**

**Location and Quantity**

| Room Number | Room Name | Quantity |
|---|---|---|
| 1031 | CONTRACTOR SUPPORT | 6 |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | **TOTAL** | **6** |

## LOBBY

**CH5 CHAIR, WAITING**
MFR: HERMAN MILLER
SERIES: VERUS SIDE CHAIR WITH ARMS
SEAT AND BACK UPHOLSTERY: SEQUEL NAVY, 3SL28
BASE/FRAME: MINERAL
LEGS: SATIN ALUMINUM



FINISH: SATIN ALUMINUM

FINISH: SEQUEL NAVY

FINISH: MINERAL

FINISH: PHANTOM COCOA

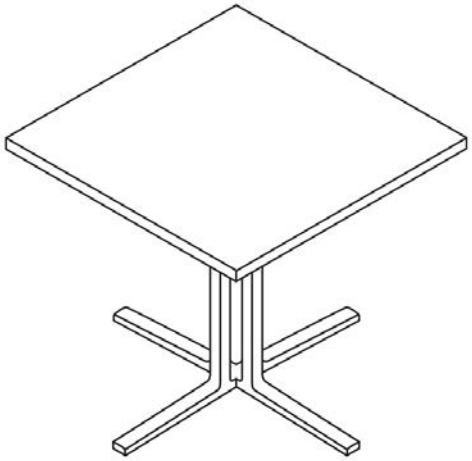


FINISH: SANDSTONE

**T3 TABLE, SIDE**
MFR: HERMAN MILLER
SERIES: EVERYWHERE
LAMINATE: PHANTOM COCOA, LBS
BASE: SANDSTONE, WL

**FF&E-1**

## BREAK ROOM



**T1 TABLE, DINING**
MFR: HERMAN MILLER
SERIES: ANYWHERE TABLE
TOP: PHANTOM COCOA, LBS
BASE: SANDSTONE, WL

FINISH: PHANTOM COCOA



FINISH: GRAPHITE SATIN

**CH2 CHAIR, DINING**
MFR: HERMAN MILLER
SERIES: CAPER STACK CHAIR
SEAT & BACK: BERRY BLUE, 3M
FRAME: METALLIC SILVER, MS
ARMS: SILVER GREY, SY

FINISH: METALLIC SILVER

FINISH: BERRY BLUE, 3M

FINISH: SILVER GREY, SY

## WELLNESS

**CH4 CHAIR, RECLINER**
MFR: HERMAN MILLER
SERIES: PAMONA
FULL UPHOLSTERY: NIMBLE 88S01 PALLADIUM
ARM CAPS: DARK BROWN WALNUT 40

FINISH: NIMBLE PALLADIUM

FINISH: DARK BROWN WALNUT

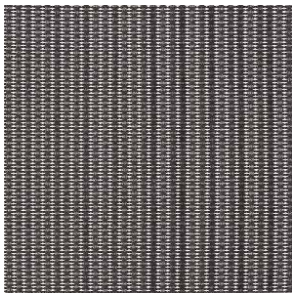
**T2 TABLE, OCCASIONAL**
MFR: HERMAN MILLER
SERIES: STRIAD PEDESTAL
LAMINATE: WARM GREY NEUTRAL, WN
BASE: POLISHED ALUMINUM, PA

FINISH: POLISHED ALUMINUM

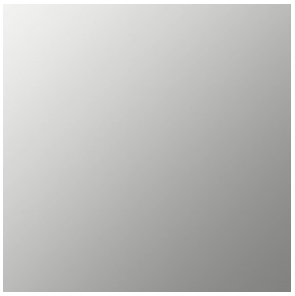
FINISH: WARM GREY NEUTRAL

**FF&E-3**

## OPEN OFFICE

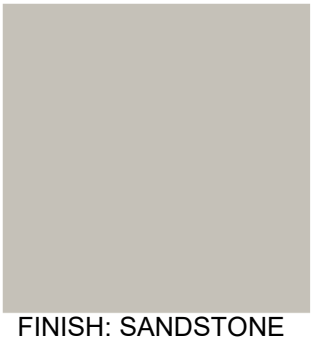


FINISH: 8Z PELLICLE GRAPHITE

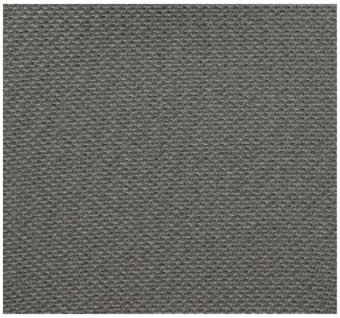


FINISH: POLISHED ALUMINUM

**CH1, CHAIR, TASK**
MFR: HERMAN MILLER
SERIES: AERON
SEAT/BACK: 8Z PELLICLE, GRAPHITE 23103
BASE/FRAME: POLISHED ALUMINUM CD



FINISH: SANDSTONE



FINISH: GEM, SLATE GREY

FINISH: PHANTOM COCOA

**WS1, WORKSTATION – 6X6**
**WS2, WORKSTATION – 8X8**
MFR: HERMAN MILLER
SERIES: CANVAS OFFICE
PAINT: SANDSTONE, WL
WORKSURFACE: PHANTOM COCOA, LBS
TACKBOARD: GEM, SLATE GREY, 9515

## OPEN OFFICE

FINISH: SANDSTONE
WL

FINISH: PHANTOM
COCOA LBS

**ST1, STORAGE**
MFR: HERMAN MILLER
SERIES: MERIDIAN STANDARD PULL
DOORS/TOP: PHANTOM COCOA LBS
METAL: SANDSTONE WL

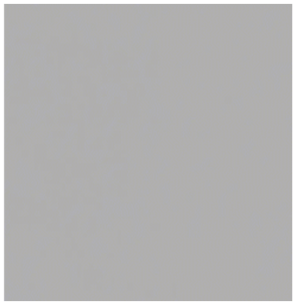
FINISH: SANDSTONE
WL

**ST2, STORAGE**
MFR: HERMAN MILLER
SERIES: MERIDIAN BAR-PULL FREESTANDING
LATERAL FILE
METAL: SANDSTONE WL

## CONFERENCE ROOM

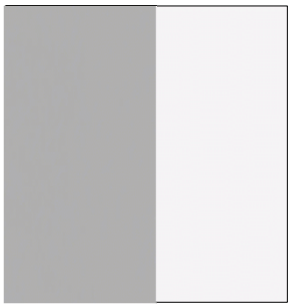
FINISH: DARK TURQUOISE

FINISH: SLATE GREY

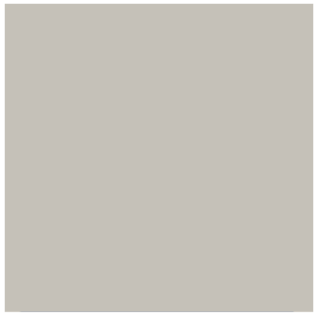


FINISH: FOG GREY

**CH7, CHAIR, CONFERENCE**
MFR: HERMAN MILLER
SERIES: MIRRA 2
BACK: SLATE GREY
SEAT: DARK TURQUOISE
BASE/FRAME: SEMI POLISHED AND WHITE



FINISH: SEMI POLISHED AND WHITE

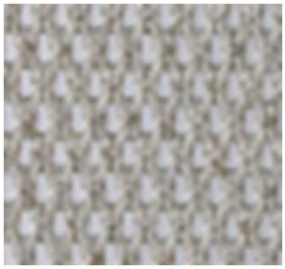


FINISH: SANDSTONE

FINISH: PHANTOM COCOA

**T5, TABLE, CONFERENCE**
MFR: HERMAN MILLER
SERIES: HEADWAY TABLE
PAINT: SANDSTONE, WL
WORKSURFACE: PHANTOM COCOA, LBS

## TRAINING ROOM



FINISH: SILVER GREY 3M

FINISH: SILVER GREY 3Y

FINISH: METALLIC SILVER MS

**CH6, CHAIR, TRAINING**
MFR: HERMAN MILLER
SERIES: CAPER STACKING
SEAT/BACK: FLEXNET SILVER GREY 3M
BASE/FRAME: METALLIC SILVER MS
ARMS: SILVER GREY 3M

FINISH: SANDSTONE

FINISH: PHANTOM COCOA

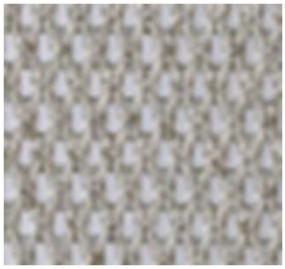
**T4, TABLE, TRAINING**
MFR: HERMAN MILLER
SERIES: EVERYWHERE TABLE – FLIP TOP
PAINT: SANDSTONE, WL
WORKSURFACE: PHANTOM COCOA, LBS

FINISH: FAWN CYPRESS

**L1, LECTERN**
MFR: ENWORK
SERIES: LIGOURI LECTURN
FINISH: FAWN CYPRESS

**FF&E-7**

## SMALL WLT



FINISH: SILVER GREY 3M

FINISH: SILVER GREY 3Y

FINISH: METALLIC SILVER MS

**CH6, TASK CHAIR**
MFR: HERMAN MILLER
SERIES: CAPER STACKING
SEAT/BACK: FLEXNET SILVER GREY 3M
BASE/FRAME: METALLIC SILVER MS
ARMS: SILVER GREY 3M

FINISH: SANDSTONE

FINISH: PHANTOM COCOA

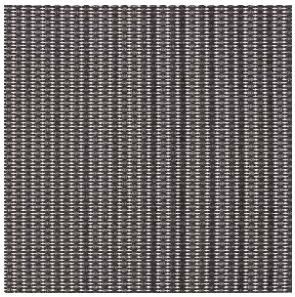
**T4, TABLE, TRAINING**
MFR: HERMAN MILLER
SERIES: EVERYWHERE TABLE – FLIP TOP
PAINT: SANDSTONE, WL
WORKSURFACE: PHANTOM COCOA, LBS

FINISH: SANDSTONE

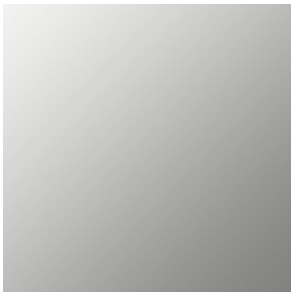
FINISH: PHANTOM COCOA

**T6, TABLE, CONFERENCE, SMALL**
MFR: HERMAN MILLER
SERIES: HEADWAY TABLE
PAINT: SANDSTONE, WL
WORKSURFACE: PHANTOM COCOA, LBS

## WING MGR/WS SUPER



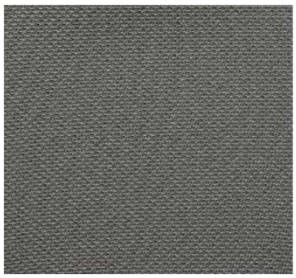
FINISH: 8Z PELLICLE GRAPHITE



FINISH: POLISHED ALUMINUM

**CH1, CHAIR, TASK**
MFR: HERMAN MILLER
SERIES: AERON
SEAT/BACK: 8Z PELLICLE, GRAPHITE 23103
BASE/FRAME: POLISHED ALUMINUM CD

FINISH: SANDSTONE



FINISH: GEM, SLATE GREY

FINISH: PHANTOM COCOA

**D1, DESK, L-SHAPED**
MFR: HERMAN MILLER
SERIES: CANVAS OFFICE
PAINT: SANDSTONE, WL
WORKSURFACE: PHANTOM COCOA, LBS
TACKBOARD: GEM, SLATE GREY, 9515

FINISH: FEATHER GREY 1HA09

FINISH: DARK BROWN WALNUT 40

**CH3, CHAIR, SIDE**
MFR: HERMAN MILLER
SERIES: FULL TWIST GUEST CHAIR
SEAT: : FEATHER GREY 1HA09
BASE/FRAME: : DARK BROWN WALNUT 40

**FF&E MATERIAL LEGEND**
**B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)**
**ELLSWORTH AFB, SD**
**PROJECT: FXBM231802**

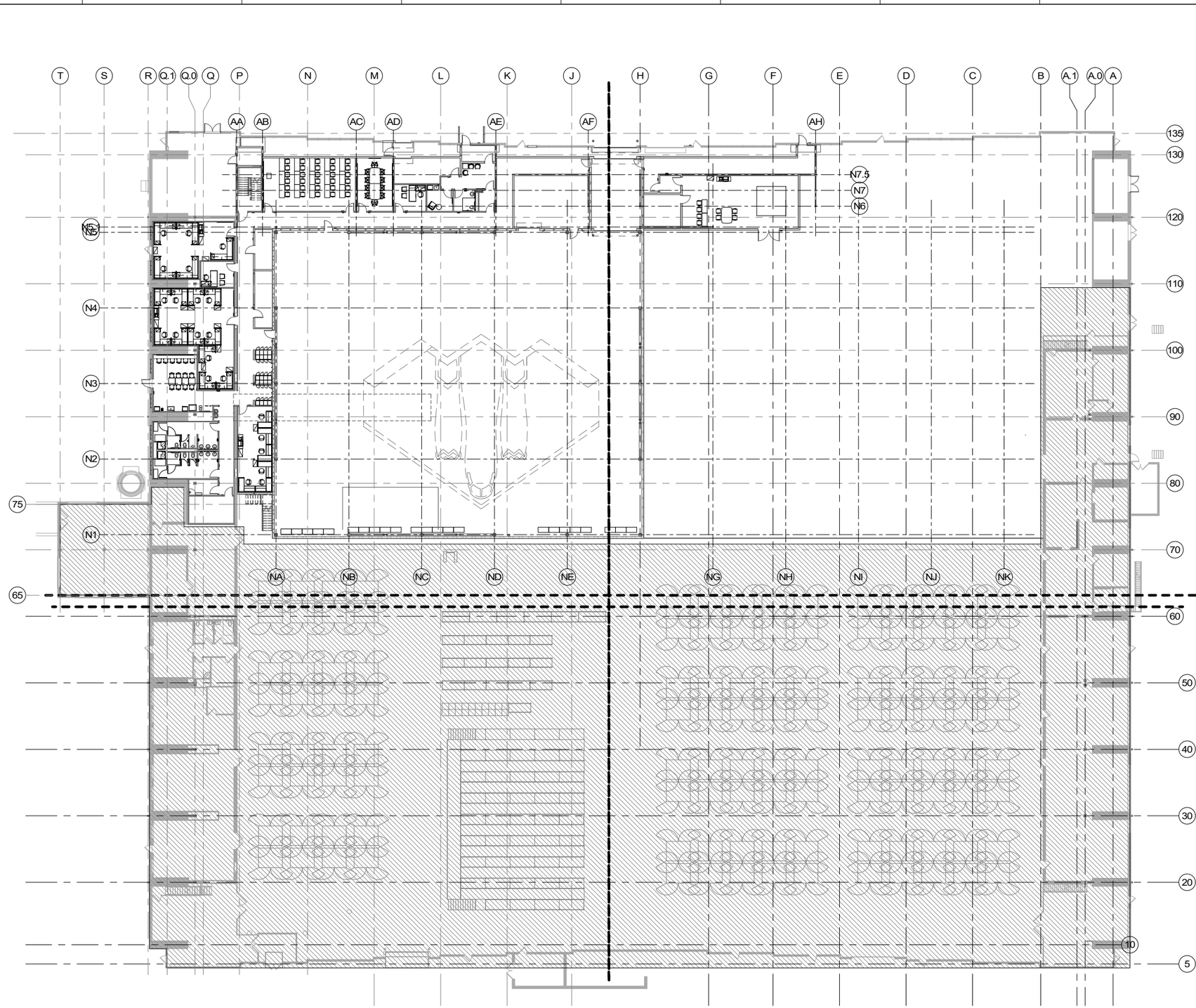
| ITEM | DESCRIPTION | IMAGE | FINISH SELECTIONS |
|---|---|---|---|
| CH1 | **Chair, Task -**<br>**Mfr:** Herman Miller<br>**Style**: Aeron | | SEAT/BACK<br>HERMAN MILLER<br>STYLE: 8Z PELLICLE<br>COLOR: GRAPHITE 23103<br>BASE<br>HERMAN MILLER<br>COLOR: POLISHED ALUMINUM CD |
| CH2 | **Chair, Dining -**<br>**Mfr:** Herman Miller<br>**Style**: Caper Stack Chair | | SEAT/BACK<br>HERMAN MILLER<br>COLOR: BERRY BLUE, 3M<br>ARMS<br>HERMAN MILLER<br>COLOR: SILVER GREY SY<br>FRAME<br>HERMAN MILLER<br>COLOR: METALLIC SILVER MS |
| CH3 | **Chair, Guest -**<br>**Mfr:** Herman Miller<br>**Style**: Full Twist Guest Chair | | SEAT<br>HERMAN MILLER<br>STYLE: MEDLEY<br>COLOR: FEATHER GREY 1HA09<br>BACK/ARMS/FRAME<br>HERMAN MILLER<br>COLOR: DARK BROWN WALNUT 40 |
| CH4 | **Chair, Recliner -**<br>**Mfr:** Herman Miller<br>**Style**: Aeron | | UPHOLSTERY<br>HERMAN MILLER<br>STYLE: NIMBLE<br>COLOR: 88S01 PALLADIUM<br>ARM CAPS<br>HERMAN MILLER<br>COLOR: : DARK BROWN WALNUT 40 |
| CH5 | **Chair, Waiting -**<br>**Mfr:** Herman Miller<br>**Style**: Verus Side Chair | | SEAT/BACK<br>HERMAN MILLER<br>STYLE: SEQUEL<br>COLOR: NAVY 3SL28<br>FRAME<br>HERMAN MILLER<br>COLOR: MINERAL<br>LEGS<br>HERMAN MILLER<br>COLOR: SATIN ALUMINUM |
| CH6 | **Chair, Training -**<br>**Mfr:** Herman Miller<br>**Style**: Caper Stacking | | SEAT/BACK<br>HERMAN MILLER<br>STYLE: FLEXNET<br>COLOR: SILVER GREY 3M<br>ARMS<br>HERMAN MILLER<br>COLOR: SILVER GREY SY<br>FRAME<br>HERMAN MILLER<br>COLOR: METALLIC SILVER MS |
| CH7 | **Chair, Conference -**<br>**Mfr:** Herman Miller<br>**Style**: Mirra | | SEAT<br>HERMAN MILLER<br>STYLE: AIRWEAVE<br>COLOR: DARK TURQUOISE<br>BACK<br>HERMAN MILLER<br>STYLE: AIRWEAVE<br>COLOR: SLATE GREY<br>ARMS<br>HERMAN MILLER<br>COLOR: FOG GREY<br>BASE/FRAME<br>HERMAN MILLER<br>COLOR:Semi-Polished Base with Studio White Frame |
| CL1 | **Wall Clock -**<br>**Mfr:** Howard Miller<br>**Style**: 625-207 | | FRAME<br>COLOR: NICKEL<br>DIAL<br>COLOR: WHITE |

**FF&E MATERIAL LEGEND**
**B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)**
**ELLSWORTH AFB, SD**
**PROJECT: FXBM231802**

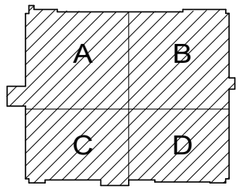
| ITEM | DESCRIPTION | IMAGE | FINISH SELECTIONS |
|---|---|---|---|
| D1 | **Desk, L-Shaped -**<br>**Mfr:** Herman Miller<br>**Style**: Canvas Office | | TACKBOARD<br>HERMAN MILLER<br>STYLE: GEM<br>COLOR: SLATE GREY 9515<br>LAMINATE TOP/FRONT/SIDE PANELS<br>HERMAN MILLER<br>STYLE: GEM<br>COLOR: SLATE GREY 9515<br>METAL STORAGE/LEG FINISH<br>HERMAN MILLER<br>COLOR: SANDSTONE WL |
| DB1 | **Display Board, Glass Front -**<br>**Mfr:** Global Industrail<br>**Style**: Enclosed Cork Bulletin Board | | FRAME<br>COLOR: ANODIZED ALUMINUM<br>BACK<br>COLOR: CORK |
| L1 | **Lectern -**<br>**Mfr:** Enwork<br>**Style**: Ligouri Lectern | | LAMINATE<br>ENWORK<br>COLOR: FAWN CYPRESS |
| MA1 | **Trash/Recycling Receptacle -**<br>**Mfr:** Mangnuson Group<br>**Style**: Valuta | | BODY/TOP<br>MAGNUSON GROUP<br>COLOR: ANODIZED SILVER<br>PICTOGRAMS<br>MAGNUSON GROUP<br>COLOR: WHITE |
| MA2 | **Recycle Bin, Deskside -**<br>**Mfr:** Uline<br>**Style**: Office Recycling Container - 7 Gallon | | |
| MA3 | **Trash Bin, Deskside-**<br>**Mfr:** Uline<br>**Style**: Office Trash Can - 7 Gallon | | |
| ST1 | **Storage 2 Door Cabinet-**<br>**Mfr:** Herman Miller<br>**Style**: Meridian Standard Pull | | LAMINATE DOORS/TOP<br>HERMAN MILLER<br>COLOR: PHANTOM COCOA LBS<br>METAL<br>HERMAN MILLER<br>COLOR: SANDSTONE WL |
| ST2 | **Storage 4 Door Lateral File-**<br>**Mfr:** Herman Miller<br>**Style**:Meridian Bar-Pull Freestanding Lateral File | | METAL<br>HERMAN MILLER<br>COLOR: SANDSTONE WL |

**FF&E MATERIAL LEGEND**
**B-21 WEAPONS LOADER TRAINING FACILITY (WLT #1) (FY23)**
**ELLSWORTH AFB, SD**
**PROJECT: FXBM231802**

| ITEM | DESCRIPTION | IMAGE | FINISH SELECTIONS |
|---|---|---|---|
| T1 | **Table Dining-**<br>**Mfr:** Herman Miller<br>**Style**: Everywhere Table | | LAMINATE TOP<br>HERMAN MILLER<br>COLOR: PHANTOM COCOA LBS<br>METAL BASE<br>HERMAN MILLER<br>COLOR: SANDSTONE WL |
| T2 | **Table Occasional-**<br>**Mfr:** Herman Miller<br>**Style**: Striad Pedestal SideTable | | LAMINATE TOP<br>HERMAN MILLER<br>COLOR: WARM GREY NEUTRAL WN<br>METAL BASE<br>HERMAN MILLER<br>COLOR: POLISHED ALUMINUM PA |
| T3 | **Table Side-**<br>**Mfr:** Herman Miller<br>**Style**: Occasional Table | | LAMINATE TOP<br>HERMAN MILLER<br>COLOR: PHANTOM COCOA LBS<br>METAL BASE<br>HERMAN MILLER<br>COLOR: SANDSTONE WL |
| T4 | **Table Training-**<br>**Mfr:** Herman Miller<br>**Style**: Everywhere Table - Flip Top | | LAMINATE TOP<br>HERMAN MILLER<br>COLOR: PHANTOM COCOA LBS<br>METAL BASE<br>HERMAN MILLER<br>COLOR: SANDSTONE WL |
| T5 | **Table Conference-**<br>**Mfr:** Herman Miller<br>**Style**: Headway Table | | LAMINATE TOP<br>HERMAN MILLER<br>STYLE:<br>COLOR: PHANTOM COCOA LBS<br>METAL BASE<br>HERMAN MILLER<br>STYLE:<br>COLOR: SANDSTONE WL |
| T6 | **Table Conference Small-**<br>**Mfr:** Herman Miller<br>**Style**: Headway Table | | LAMINATE TOP<br>HERMAN MILLER<br>COLOR: PHANTOM COCOA LBS<br>METAL BASE<br>HERMAN MILLER<br>COLOR: SANDSTONE WL |
| WS1 | **Work Station 6 x 6-**<br>**Mfr:** Herman Miller<br>**Style**: Canvas Office | | LAMINATE TOP/EDGE FINISH<br>HERMAN MILLER<br>COLOR: PHANTOM COCOA LBS<br>PANEL TRIM/BASE PAINT/METAL<br>OVERHEAD STORAGE<br>HERMAN MILLER<br>COLOR: SANDSTONE WL<br>PANEL FABRIC<br>HERMAN MILLER<br>COLOR: GEM SLATE GREY 9515 |
| WS2 | **Work Station 8 x 8-**<br>**Mfr:** Herman Miller<br>**Style**: Canvas Office | | LAMINATE TOP/EDGE FINISH<br>HERMAN MILLER<br>COLOR: PHANTOM COCOA LBS<br>PANEL TRIM/BASE PAINT/METAL<br>OVERHEAD STORAGE<br>HERMAN MILLER<br>COLOR: SANDSTONE WL<br>PANEL FABRIC<br>HERMAN MILLER<br>COLOR: GEM SLATE GREY 9515 |




A1 OVERALL FURNITURE PLAN - LEVEL 01 - BASE BID
SCALE 1" = 20'-0"




OVERALL
KEY PLAN

GRAPHIC SCALE
0 10' 20' 40' 60'
SCALE: 1"=20'

PLAN
NORTH
TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|
| | | |

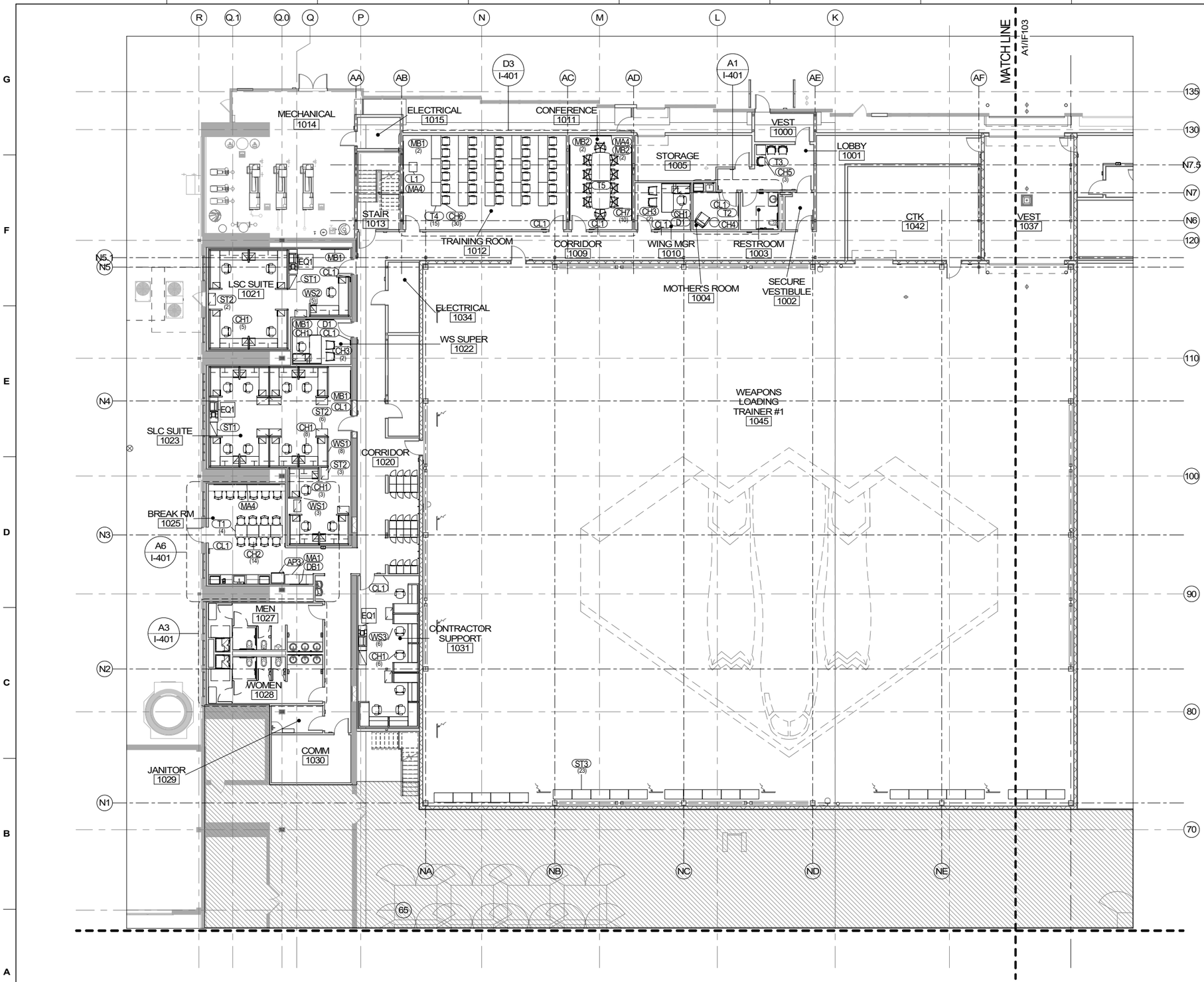
DESIGNED BY: M. ABOVE
DRAWN BY: M. ABOVE
CHECKED BY: T. SIGUR
SUBMITTED BY: B. DYSON
ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912BF23R0012
CONTRACT NO.: W912DQ21D4017
DRAWING CODE: ANSI D 22x34
FILE NAME: FXBM231802IF101

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
OVERALL FURNITURE PLAN - LEVEL 01

SHEET ID
IF101




A1 PARTIAL FURNITURE PLAN - LEVEL 01 - AREA A
SCALE 3/32" = 1'-0"

## GENERAL SHEET NOTES

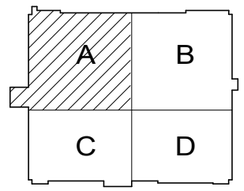
1. ITEMS SHOWN IN THE FF&E LEGEND INDICATE ITEMS PROVIDED AND INSTALLED BY THE CONTRACTOR. ITEMS SHOWN IN THE GFGI LEGEND INDICATE ITEMS INTENDED FOR INFORMATIONAL / COORDINATION PURPOSES ONLY AND ARE NOT IN CONTRACT.
2. FF&E PACKAGE IS PROVIDED AS A BASIS OF DESIGN. FINAL FF&E ITEMS ARE TO BE APPROVED BY THE USERS PRIOR TO PROCUREMENT AND INSTALLATION.
3. FURNITURE CONTRACTOR TO FIELD VERIFY ROOM DIMENSIONS AND COORDINATE FURNITURE SIZES PRIOR TO PROCUREMENT AND INSTALLATION.
4. SMALL WASTE AND RECYCLE RECEPTACLES NOT SHOWN ON PLAN FOR GRAPHIC CLARITY. EACH DESK TO RECEIVE ONE (1) DESK SIDE WASTE BIN (MA3) AND ONE (1) DESK SIDE RECYCLE BIN (MA2) AS SPECIFIED.

## FF&E LEGEND - BID OPTION (CFCI)

| TAG | DESCRIPTION |
|---|---|
| AP1 | UNDERCOUNTER FRIDGE |
| AP2 | MICROWAVE |
| AP3 | REFRIGERATOR, SINGLE DOOR |
| AP4 | COFFEE POT |
| CH1 | CHAIR, TASK |
| CH2 | CHAIR, DINING |
| CH3 | CHAIR, GUEST |
| CH4 | CHAIR, RECLINER |
| CH5 | CHAIR, WAITING |
| CH6 | CHAIR, TRAINING |
| CH7 | CHAIR, CONFERENCE |
| CL1 | WALL CLOCK |
| D1 | DESK, L-SHAPED |
| DB1 | DISPLAY BOARD, GLASS FRONT |
| L1 | LECTERN |
| MA1 | TRASH/RECYCLING RECEPTACLE |
| MA4 | TELEVISION |
| MB1 | MARKERBOARD |
| MB2 | MARKERBOARD, 96" |
| ST1 | STORAGE, 2-DOOR CABINET |
| ST2 | LATERAL FILE, 4 DRAWER LATERAL FILE |
| ST3 | STORAGE, HEAVY DUTY |
| T1 | TABLE, DINING |
| T2 | TABLE, OCCASIONAL |
| T3 | TABLE, SIDE |
| T4 | TABLE, TRAINING |
| T5 | TABLE, CONFERENCE |
| T6 | TABLE, CONFERENCE SMALL |
| WS1 | WORKSTATION 6 X 6 |
| WS2 | WORKSTATION 8 X 8 |
| WS3 | WORKSTATION 5 X 6 |

## GFGI EQUIP LEGEND (BY USER)

| TAG | DESCRIPTION |
|---|---|
| EQ1 | STAND UP PRINTER / COPIER |




AREA A
KEY PLAN

GRAPHIC SCALE
0 4' 8' 16' 32'
SCALE: 3/32"=1'-0"

PLAN NORTH
TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

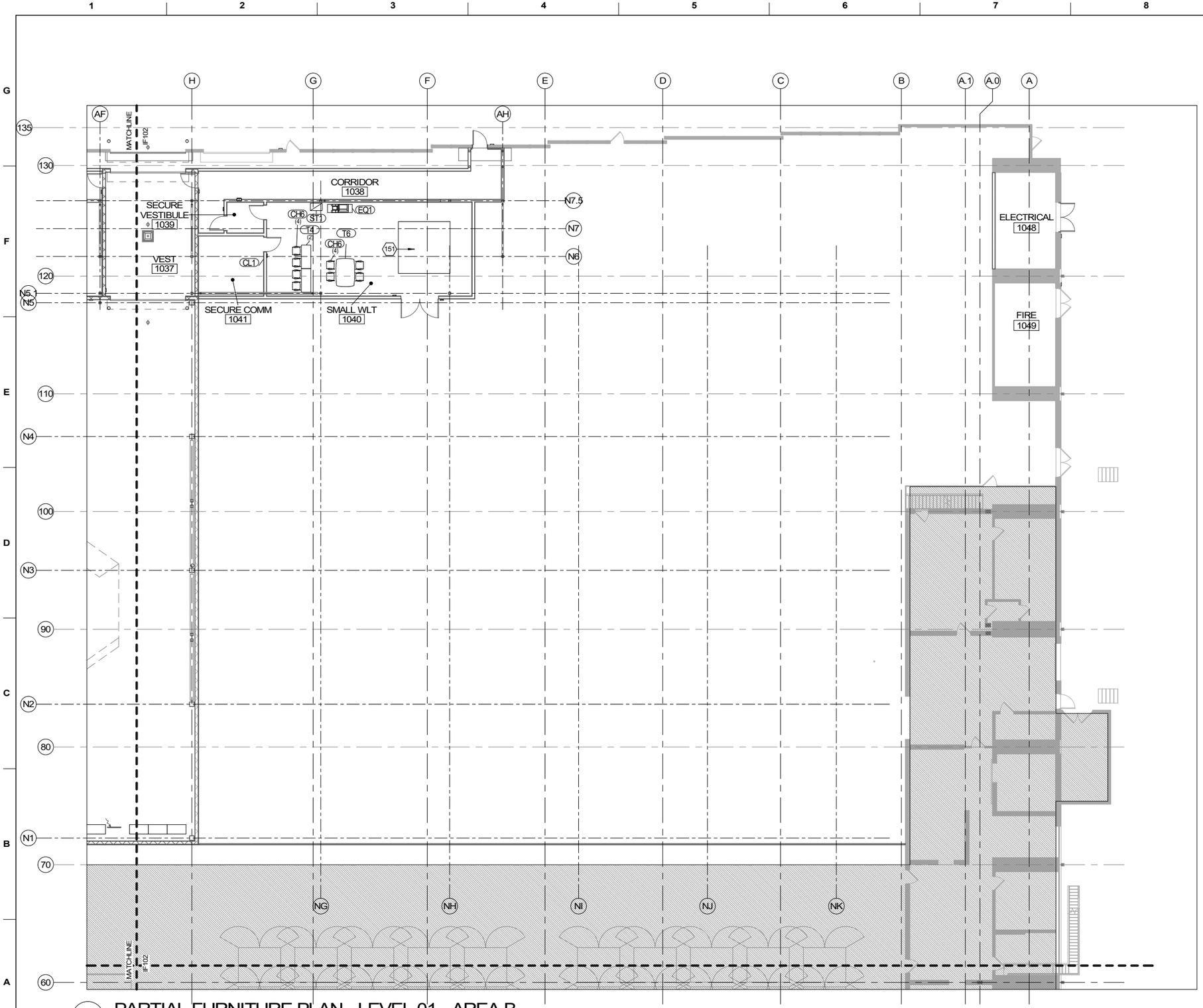
DESIGNED BY: M. ABOVE
DRAWN BY: M. ABOVE
CHECKED BY: T. SIGUR
SUBMITTED BY: B. DYSON
ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912PF23R0012
CONTRACT NO.: W912DQ21D4017
DRAWING CODE:
FILE NAME: FXBM231802F102
SIZE: ANSI D 22x34

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
PARTIAL FURNITURE PLAN - LEVEL 01 - AREA A

SHEET ID
IF102




A1 PARTIAL FURNITURE PLAN - LEVEL 01 - AREA B
SCALE 3/32" = 1'-0"

## GENERAL SHEET NOTES

1. ITEMS SHOWN IN THE FF&E LEGEND INDICATE ITEMS PROVIDED AND INSTALLED BY THE CONTRACTOR. ITEMS SHOWN IN THE GFGI LEGEND INDICATE ITEMS INTENDED FOR INFORMATIONAL / COORDINATION PURPOSES ONLY AND ARE NOT IN CONTRACT.
2. FF&E PACKAGE IS PROVIDED AS A BASIS OF DESIGN. FINAL FF&E ITEMS ARE TO BE APPROVED BY THE USERS PRIOR TO PROCUREMENT AND INSTALLATION.
3. FURNITURE CONTRACTOR TO FIELD VERIFY ROOM DIMENSIONS AND COORDINATE FURNITURE SIZES PRIOR TO PROCUREMENT AND INSTALLATION.
4. SMALL WASTE AND RECYCLE RECEPTACLES NOT SHOWN ON PLAN FOR GRAPHIC CLARITY. EACH DESK TO RECEIVE ONE (1) DESK SIDE WASTE BIN (MA3) AND ONE (1) DESK SIDE RECYCLE BIN (MA2) AS SPECIFIED.

## KEYNOTES

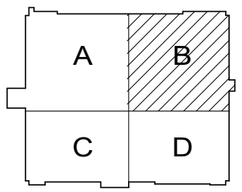
| | |
|---|---|
| 151 | OUTLINE OF SMALL WEAPONS LOADER TRAINER |

## FF&E LEGEND - BID OPTION (CFCI)

| TAG | DESCRIPTION |
|---|---|
| AP1 | UNDERCOUNTER FRIDGE |
| AP2 | MICROWAVE |
| AP3 | REFRIGERATOR, SINGLE DOOR |
| AP4 | COFFEE POT |
| CH1 | CHAIR, TASK |
| CH2 | CHAIR, DINING |
| CH3 | CHAIR, GUEST |
| CH4 | CHAIR, RECLINER |
| CH5 | CHAIR, WAITING |
| CH6 | CHAIR, TRAINING |
| CH7 | CHAIR, CONFERENCE |
| CL1 | WALL CLOCK |
| D1 | DESK, L-SHAPED |
| DB1 | DISPLAY BOARD, GLASS FRONT |
| L1 | LECTERN |
| MA1 | TRASH/RECYCLING RECEPTACLE |
| MA4 | TELEVISION |
| MB1 | MARKERBOARD |
| MB2 | MARKERBOARD, 96" |
| ST1 | STORAGE, 2-DOOR CABINET |
| ST2 | LATERAL FILE, 4 DRAWER LATERAL FILE |
| ST3 | STORAGE, HEAVY DUTY |
| T1 | TABLE, DINING |
| T2 | TABLE, OCCASIONAL |
| T3 | TABLE, SIDE |
| T4 | TABLE, TRAINING |
| T5 | TABLE, CONFERENCE |
| T6 | TABLE, CONFERENCE SMALL |
| WS1 | WORKSTATION 6 X 6 |
| WS2 | WORKSTATION 8 X 8 |
| WS3 | WORKSTATION 5 X 6 |

## GFGI EQUIP LEGEND (BY USER)

| TAG | DESCRIPTION |
|---|---|
| EQ1 | STAND UP PRINTER / COPIER |




AREA B
KEY PLAN

GRAPHIC SCALE

0 4' 8' 16' 32'
SCALE: 3/32"=1'-0"

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912BF23R0012
CONTRACT NO.: W912DQ21D4017
DRAWING CODE: IF
FILE NAME: FXBM231802IF103

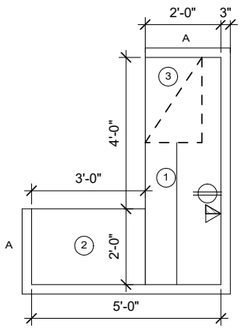
DESIGNED BY: M. ABOVE
DRAWN BY: M. ABOVE
CHECKED BY: T. SIGUR
SUBMITTED BY: B. DYSON
PRINTED ON: ANSI D 22x34

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

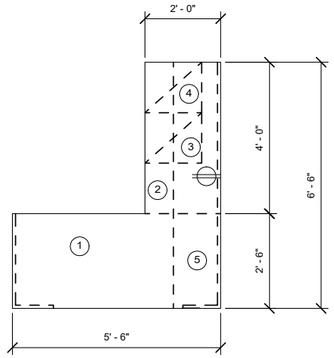
ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
PARTIAL FURNITURE PLAN - LEVEL 1 - AREA B

SHEET ID
IF103



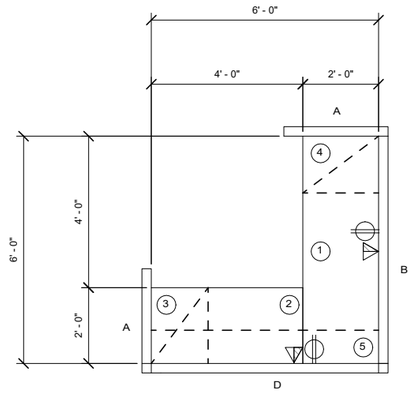

1. 24" x 72" WORKSURFACE
2. 24" X 36" RETURN
3. BOX/BOX/FILE PEDESTAL

## D1 WS3 - WORKSTATION TYPICAL
SCALE 1/2" = 1'-0"



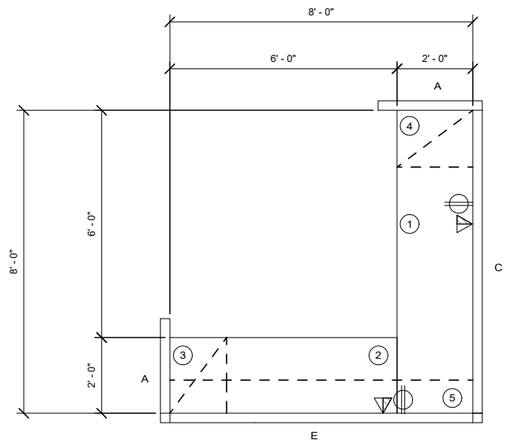

1. 30" X 66" WORKSURFACE
2. 24" X 48" RETURN
3. BOX/BOX/FILE PEDESTAL
4. FILE/FILE PEDESTAL
5. OVERHEAD STORAGE WITH TACKBOARD AND TASK LIGHTS

## D4 D1 - DESK
SCALE 1/2" = 1'-0"




1. 24" x 72" WORKSURFACE
2. 24" X 48" RETURN
3. BOX/BOX/FILE PEDESTAL
4. FILE/FILE PEDESTAL
5. OVERHEAD STORAGE WITH TACKBOARD AND TASK LIGHTS

## A1 WS1 - WORKSTATION TYPICAL
SCALE 1/2" = 1'-0"




1. 24" x 96" WORKSURFACE
2. 24" X 72" RETURN
3. BOX/BOX/FILE PEDESTAL
4. FILE/FILE PEDESTAL
5. OVERHEAD STORAGE WITH TACKBOARD AND TASK LIGHTS

## A4 WS2 - WORKSTATION TYPICAL
SCALE 1/2" = 1'-0"

# GENERAL NOTES - FF&E TYPICALS

| | |
|---|---|
| A | PROVIDE ALL ELECTRICAL CONNECTIONS, WHIPS, ETC REQUIRED TO PROVIDE POWER TO FF&E ITEMS |
| B | IT WIRING FOR FF&E (DATA/COMM) IS CONTRACTOR PROVIDED, UP TO AND INCLUDING FACEPLATES. |
| C | WORKSTATION/DESK COMPONENTS MAY BE RIGHT-HAND OR LEFT-HAND. REFER TO PLANS. |

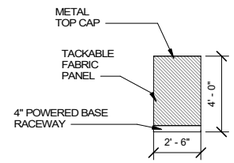
# POWER/ COMM LEGEND

- DUPLEX RECEPTACLE
- VOICE/ DATA

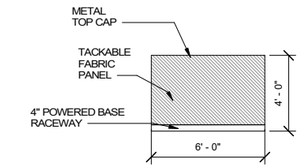
# PANEL TYPES

BASIS OF DESIGN FOR SYSTEMS PANELS IS MONOLITHIC PANELS, SIZE AS INDICATED, UTILIZING 2+2 POWER SYSTEM

PANEL TYPE A:




PANEL TYPE B:

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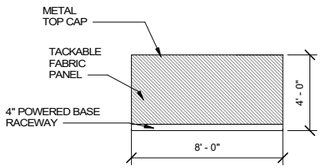
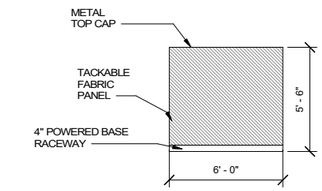
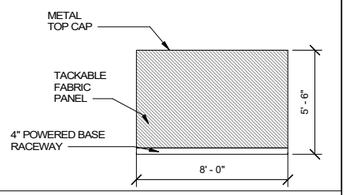



PANEL TYPE D:




PANEL TYPE E:




GRAPHIC SCALE

2 1 0 2 4

SCALE: 1/2"=1'-0"

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|
| | | |

DESIGNED BY: M. ABOVE
DRAWN BY: M. ABOVE
CHECKED BY: T. SIGUR
SUBMITTED BY: B. DYSON
ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912BF23R0012
CONTRACT NO.: W912DQ21D4017
DRAWING CODE: SF
FILE NAME: FXBM231802IF500
SIZE: ANSI D 22x34

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

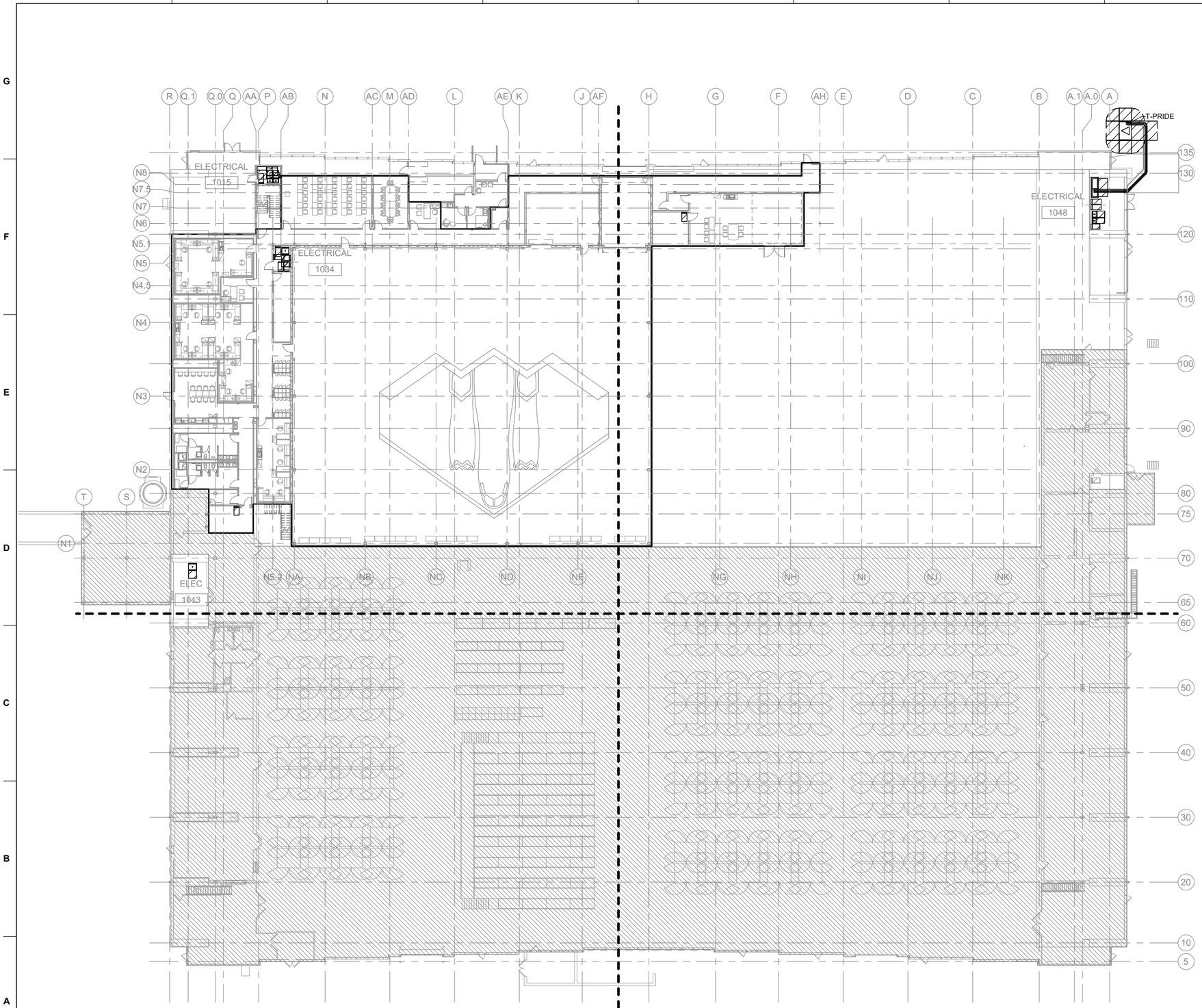
Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER
TRAINING FACILITY
PROJECT NUMBER: FXBM231802

FF&E TYPICALS

SHEET ID

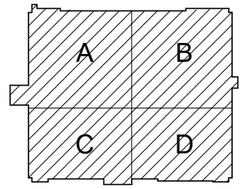
IF500




A1 OVERALL POWER PLAN - LEVEL 01
1" = 20'-0"

## GENERAL SHEET NOTES - POWER

1 FOR ADDITIONAL GROUNDING REQUIREMENTS, REFER TO GROUNDING RISER ON E5/E-602.
2 DO NOT PENETRATE WALLS MARKED WITH A DARK BLACK OUTLINE UNLESS OTHERWISE NOTED.
3 SURFACE MOUNT ELECTRICAL EQUIPMENT TO THE WEAPONS LOADING TRAINER WALLS.




OVERALL
KEY PLAN

GRAPHIC SCALE
0 10' 20' 40' 60'
SCALE: 1"=20'

PLAN NORTH
TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

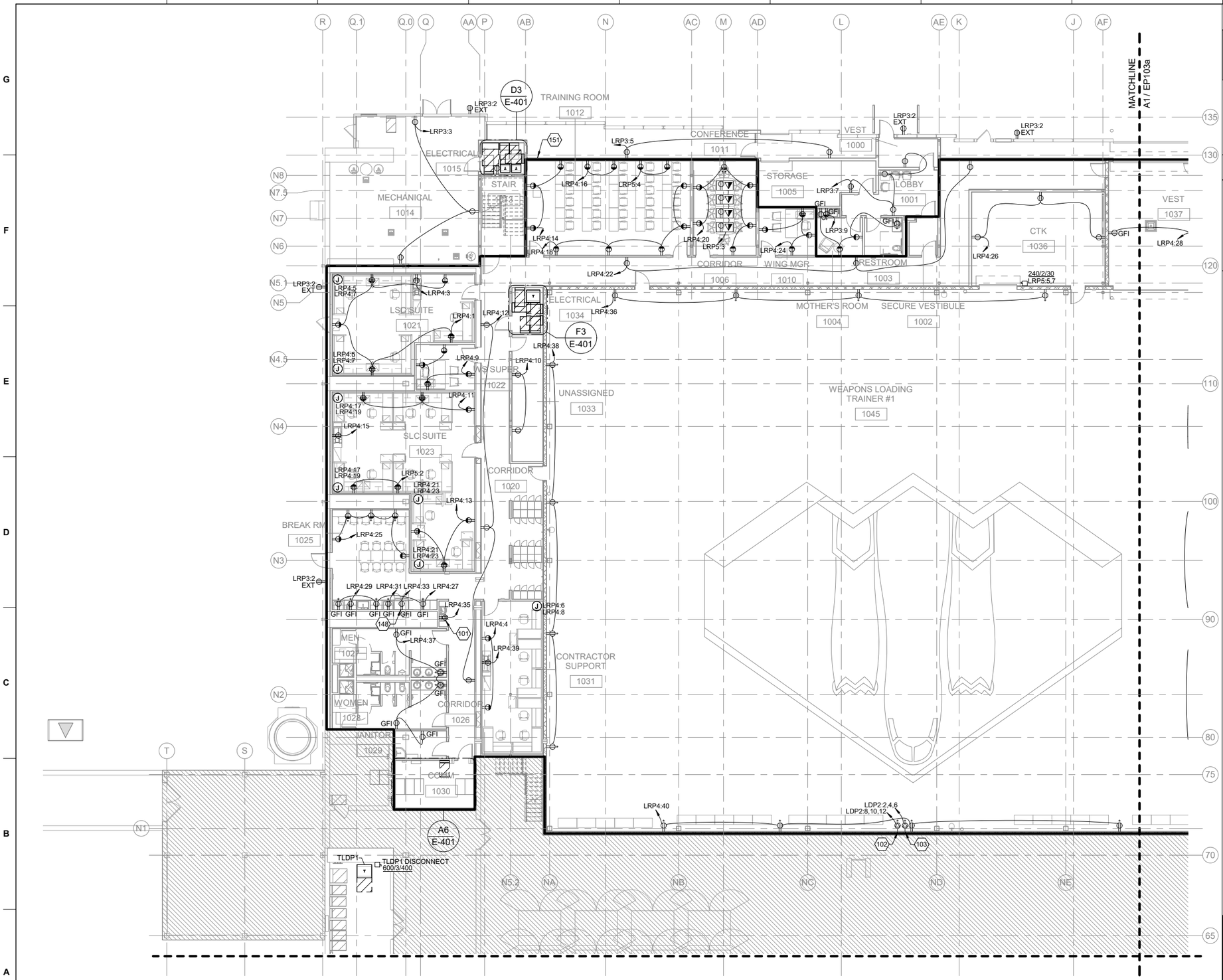
DESIGNED BY: A. GARDNER
DRAWN BY: C. KOHRMANN
CHECKED BY: K. HOGAN
SUBMITTED BY: B. DYSON
SIZE: ANSI D 22x34
ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912DQ20R4035
CONTRACT NO.: W912DQ-20-R-4035
DRAWING CODE:
FILE NAME: FXBM231802EP-101

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
OVERALL POWER PLAN - LEVEL 01

SHEET ID
EP101




## A1 PARTIAL POWER PLAN - LEVEL 01 - AREA A

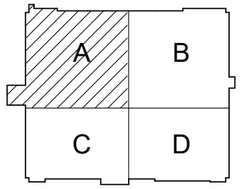
3/32" = 1'-0"

## GENERAL SHEET NOTES - POWER

1. FOR ADDITIONAL GROUNDING REQUIREMENTS, REFER TO GROUNDING RISER ON E5/E-602.
2. DO NOT PENETRATE WALLS MARKED WITH A DARK BLACK OUTLINE UNLESS OTHERWISE NOTED.
3. SURFACE MOUNT ELECTRICAL EQUIPMENT TO THE WEAPONS LOADING TRAINER WALLS.

## SHEET KEYNOTES

| | |
|---|---|
| 101 | COORDINATE RECEPTACLE INSTALLATION LOCATION WITH ELECTRIC WATER COOLER PROVIDER. INSTALL RECEPTACLE SO THAT IT IS HIDDEN FROM VIEW. PROVIDE GFI CIRCUIT BREAKER. |
| 102 | PROVIDE A 120/208 VAC, 200A, 3P+N+G CONNECTION TYPE, DS200 INLET, FOR POWERING WLT DEVICE. |
| 103 | PROVIDE A PIN AND SLEEVE 208/120V, 200A RECEPTACLE FOR PORTABLE 400 HZ CONVERTER. |
| 148 | PROVIDE REMOTE GFI PUSHBUTTON ABOVE COUNTER. PROVIDE LABEL "REFRIGERATOR GFI" ON COVER PLATE. |
| 151 | PENETRATE THROUGH WALL WITH FEEDER FOR HDP2 AND GROUNDING CONDUCTOR FOR EGB IN ELEC 1034. |




AREA A
KEY PLAN

GRAPHIC SCALE

0 4' 8' 16' 32'

SCALE: 3/32"=1'-0"

PLAN NORTH
TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

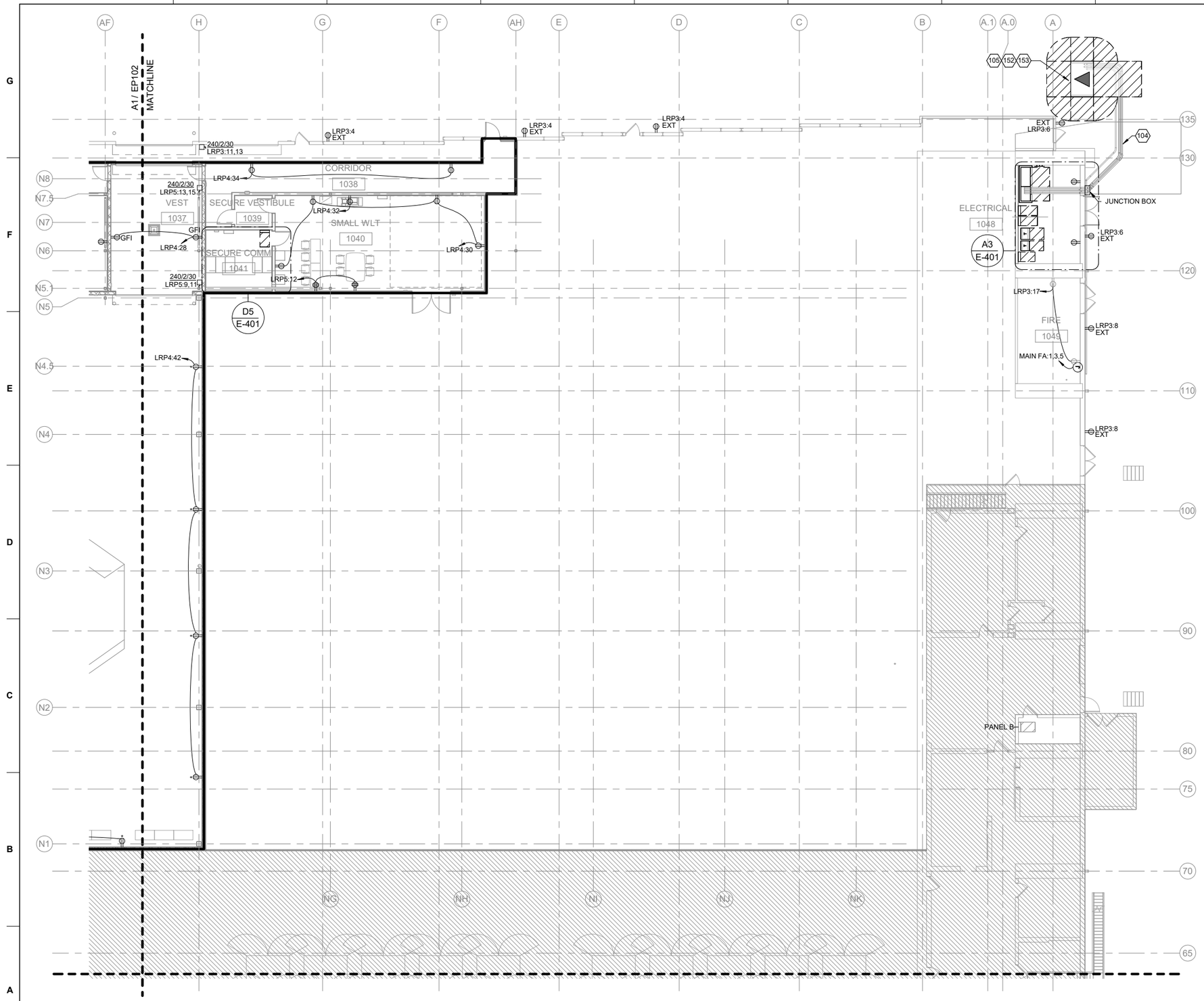
DESIGNED BY: A. GARDNER
DRAWN BY: C. KOHRMANN
CHECKED BY: K. HOGAN
SUBMITTED BY: B. DITSON
ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912DQ20R4035
CONTRACT NO.: W912DQ-20-R-4035
DRAWING CODE: D
FILE NAME: FXBM231802EP102
ANSI D 22x34

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
PARTIAL POWER PLAN - LEVEL 01 - AREA A

SHEET ID
EP102




A1 PARTIAL POWER PLAN - LEVEL 01 - AREA B - BASE BID
3/32" = 1'-0"

## GENERAL SHEET NOTES - POWER

1. FOR ADDITIONAL GROUNDING REQUIREMENTS, REFER TO GROUNDING RISER ON E5/E-602.
2. DO NOT PENETRATE WALLS MARKED WITH A DARK BLACK OUTLINE UNLESS OTHERWISE NOTED.
3. SURFACE MOUNT ELECTRICAL EQUIPMENT TO THE WEAPONS LOADING TRAINER WALLS.

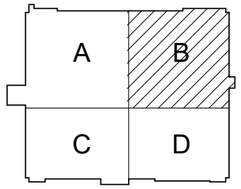
## SHEET KEYNOTES

104 RE: E-601 FOR CONDUIT AND CABLE SIZE.

105 CONDUIT PATHWAY FROM THE SWITCH S8A1 TO T-PRIDE MAY BE REUSED, PROVIDED THAT THE CONDUIT IS RODDED AND CLEANED PRIOR TO THE INSTALLATION OF NEW MEDIUM VOLTAGE CABLING. RE: CU101 FOR EXISTING ROUTE. IF THE CONDUIT IS FOUND TO BE IN POOR CONDITION REQUIRING REPLACEMENT, CONTACT THE CONTRACTING OFFICER FOR INSTRUCTIONS ON HOW TO PROCEED.

152 PROVIDE A FIBERGLASS BOX PAD BELOW TRANSFORMER. CUT CONDUITS FROM EXISTING SWITCH S8A1 AFTER REMOVING EXISTING CABLES SO THAT THE PAD CAN BE INSTALLED.

153 PROVIDE NEW CONDUIT INTO THE FIBERGLASS BOX PAD. CONNECT TO EXISTING CONDUITS THAT WERE CUT. MATCH EXISTING TYPE AND SIZE.




AREA B
KEY PLAN

GRAPHIC SCALE

0 4' 8' 16' 32'
SCALE: 3/32"=1'-0"

PLAN NORTH
TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

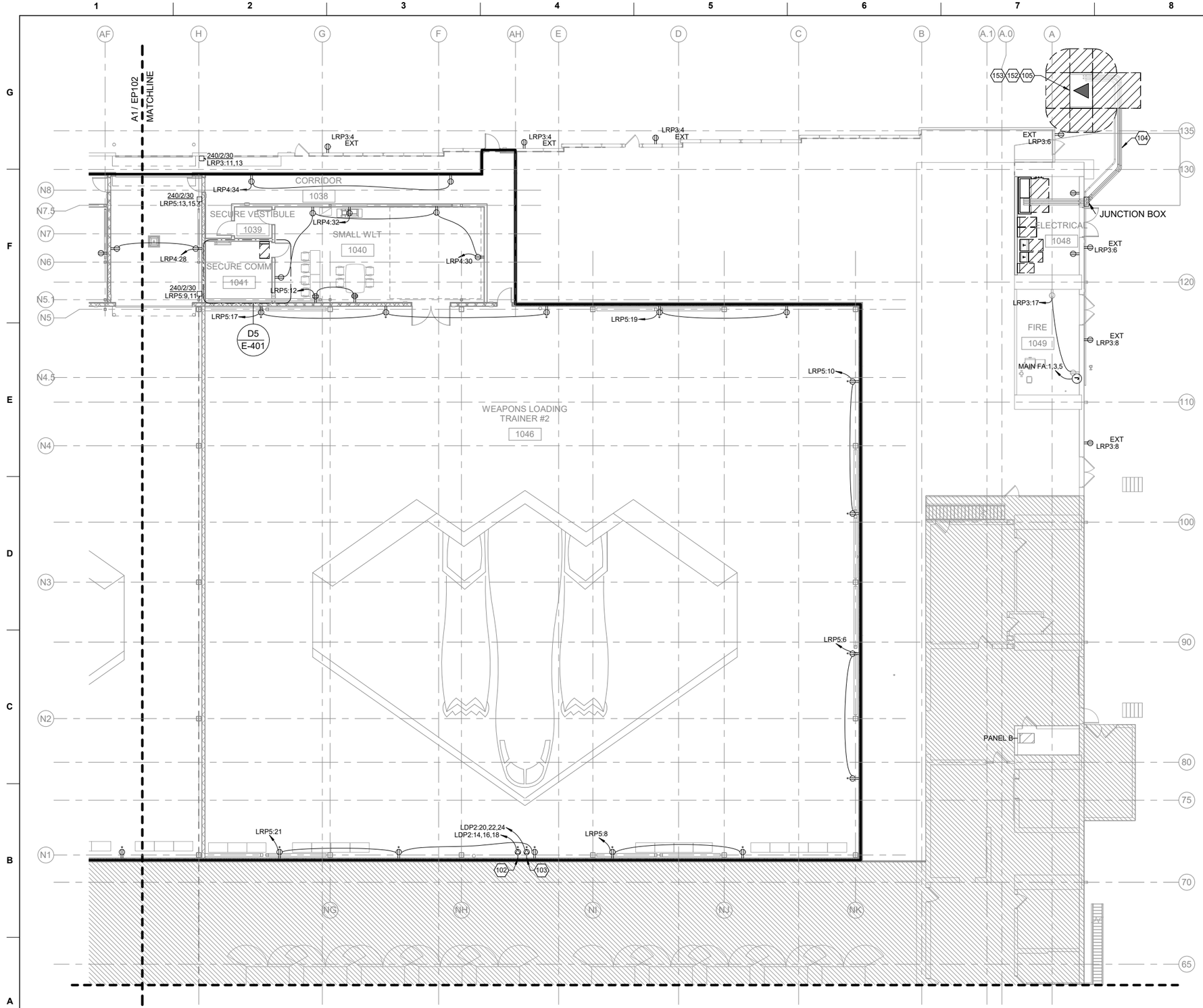
DESIGNED BY: A. GARDNER
DRAWN BY: C. KOHRMANN
CHECKED BY: K. HOGAN
SUBMITTED BY: B. DYSON
SIZE: ANSI D 22x34
ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912DQ20R4035
CONTRACT NO.: W912DQ-20-R-4035
DRAWING CODE:
FILE NAME: FXBM231802EP-103a

US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER
TRAINING FACILITY
PROJECT NUMBER: FXBM231802
PARTIAL POWER PLAN - LEVEL 01 - AREA
B - BASE BID

SHEET ID
EP103a




A1 PARTIAL POWER PLAN - LEVEL 01 - AREA B - BID OPTION
3/32" = 1'-0"

## GENERAL SHEET NOTES - POWER

1. FOR ADDITIONAL GROUNDING REQUIREMENTS, REFER TO GROUNDING RISER ON E5/E-602.
2. DO NOT PENETRATE WALLS MARKED WITH A DARK BLACK OUTLINE UNLESS OTHERWISE NOTED.
3. SURFACE MOUNT ELECTRICAL EQUIPMENT TO THE WEAPONS LOADING TRAINER WALLS.

## SHEET KEYNOTES

102 PROVIDE A 120/208 VAC, 200A, 3P+N+G CONNECTION TYPE, DS200 INLET, FOR POWERING WLT DEVICE.

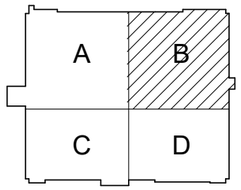
103 PROVIDE A PIN AND SLEEVE 208/120V, 200A RECEPTACLE FOR PORTABLE 400 HZ CONVERTER.

104 RE: E-601 FOR CONDUIT AND CABLE SIZE.

105 CONDUIT PATHWAY FROM THE SWITCH S8A1 TO T-PRIDE MAY BE REUSED, PROVIDED THAT THE CONDUIT IS RODDED AND CLEANED PRIOR TO THE INSTALLATION OF NEW MEDIUM VOLTAGE CABLING. RE: CU101 FOR EXISTING ROUTE. IF THE CONDUIT IS FOUND TO BE IN POOR CONDITION REQUIRING REPLACEMENT, CONTACT THE CONTRACTING OFFICER FOR INSTRUCTIONS ON HOW TO PROCEED.

152 PROVIDE A FIBERGLASS BOX PAD BELOW TRANSFORMER. CUT CONDUITS FROM EXISTING SWITCH S8A1 AFTER REMOVING EXISTING CABLES SO THAT THE PAD CAN BE INSTALLED.

153 PROVIDE NEW CONDUIT INTO THE FIBERGLASS BOX PAD. CONNECT TO EXISTING CONDUITS THAT WERE CUT. MATCH EXISTING TYPE AND SIZE.




AREA B
KEY PLAN

GRAPHIC SCALE
0 4' 8' 16' 32'
SCALE: 3/32"=1'-0"

PLAN NORTH
TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

DESIGNED BY: A. GARDNER
DRAWN BY: C. KOHRMANN
CHECKED BY: K. HOGAN
SUBMITTED BY: B. DYSON
SIZE: ANSI D 22x34
ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912DQ20R4035
CONTRACT NO.: W912DQ-20-R-4035
DRAWING CODE: EP
FILE NAME: FXBM221802EP-103b

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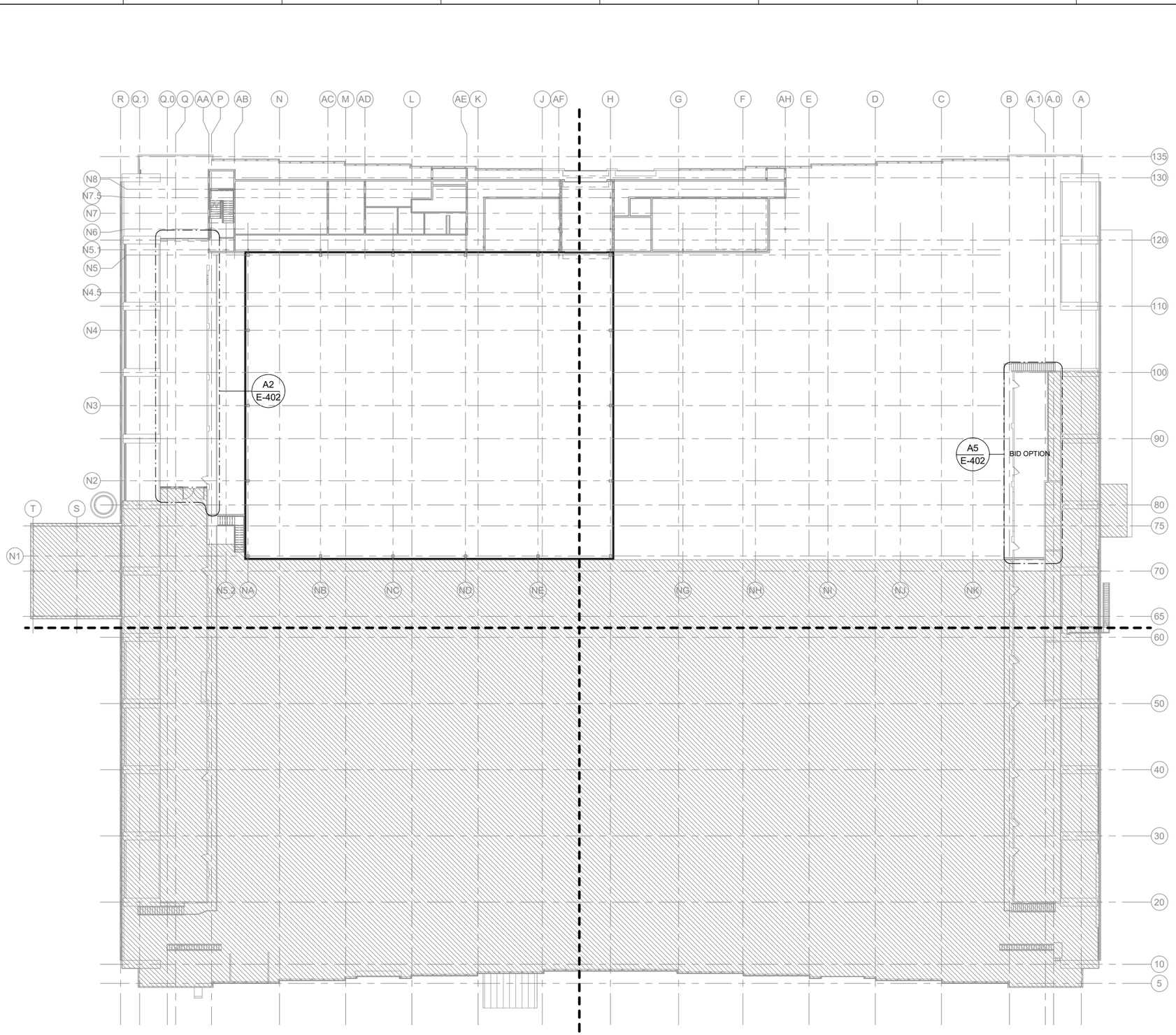
OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
PARTIAL POWER PLAN - LEVEL 01 - AREA B - BID OPTION

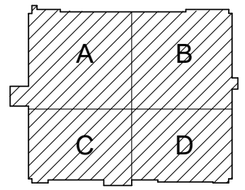
SHEET ID
EP103b




A1 OVERALL POWER PLAN - EQUIPMENT PLATFORM 01
1" = 20'-0"

## GENERAL SHEET NOTES - POWER

1 FOR ADDITIONAL GROUNDING REQUIREMENTS, REFER TO GROUNDING RISER ON E5/E-602.
2 DO NOT PENETRATE WALLS MARKED WITH A DARK BLACK OUTLINE UNLESS OTHERWISE NOTED.
3 SURFACE MOUNT ELECTRICAL EQUIPMENT TO THE WEAPONS LOADING TRAINER WALLS.




OVERALL
KEY PLAN

GRAPHIC SCALE
0 10' 20' 40' 60'
SCALE: 1"=20'

PLAN NORTH
TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

DESIGNED BY: A. GARDNER
DRAWN BY: C. KOHRMANN
CHECKED BY: K. HOGAN
SUBMITTED BY: B. DITSON
FILE: ANSI D 22x34

ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912DQ20R4035
CONTRACT NO.: W912DQ-20-R-4035
DRAWING CODE:
FILE NAME: FXBM231802EP111

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OMAHA, NEBRASKA

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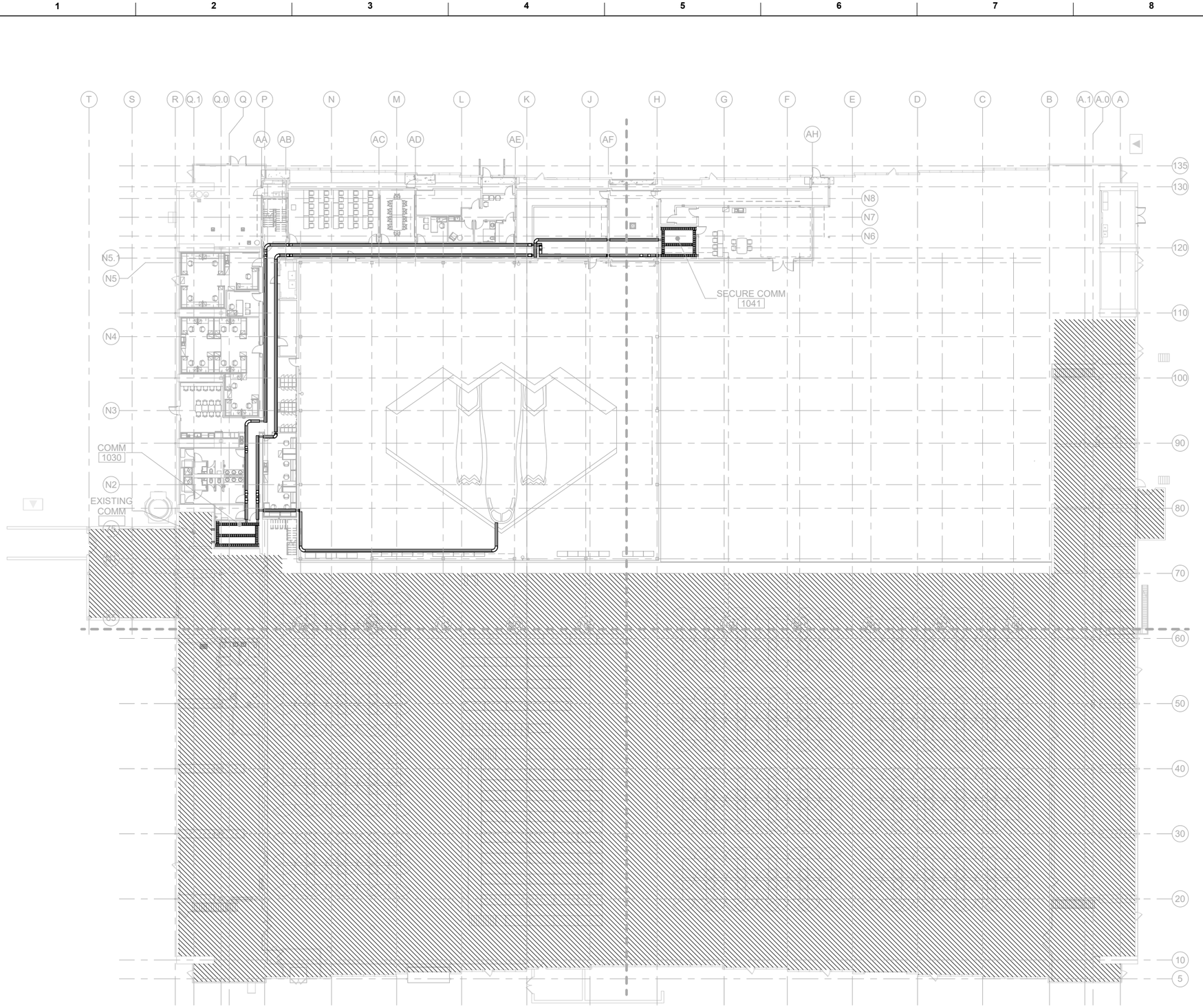
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
OVERALL POWER PLAN - EQUIPMENT PLATFORM 01

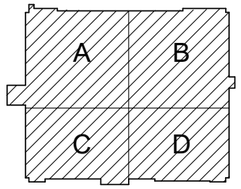
SHEET ID
EP111




A1 OVERALL TELECOMMUNICATION PLAN- LEVEL 01
1" = 20'-0"

## GENERAL SHEET NOTES

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES REFER TO SHEET TY001.




OVERALL
KEY PLAN

GRAPHIC SCALE
0 10' 20' 40' 60'
SCALE: 1"=20'

PLAN
NORTH
TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

| | |
|---|---|
| DESIGNED BY: | R. FAUVELLE |
| DRAWN BY: | C. TINKER |
| CHECKED BY: | M. ADKISON |
| SUBMITTED BY: | B. DYSON |
| SCALE: | ANSI D 22x34 |
| ISSUE DATE: | 9 MARCH 2023 |
| SOLICITATION NO.: | W912DQ20R4035 |
| CONTRACT NO.: | W912DQ-20-R-4035 |
| DRAWING CODE: | |
| FILE NAME: | FXBM231802T-101 |

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OMAHA, NEBRASKA

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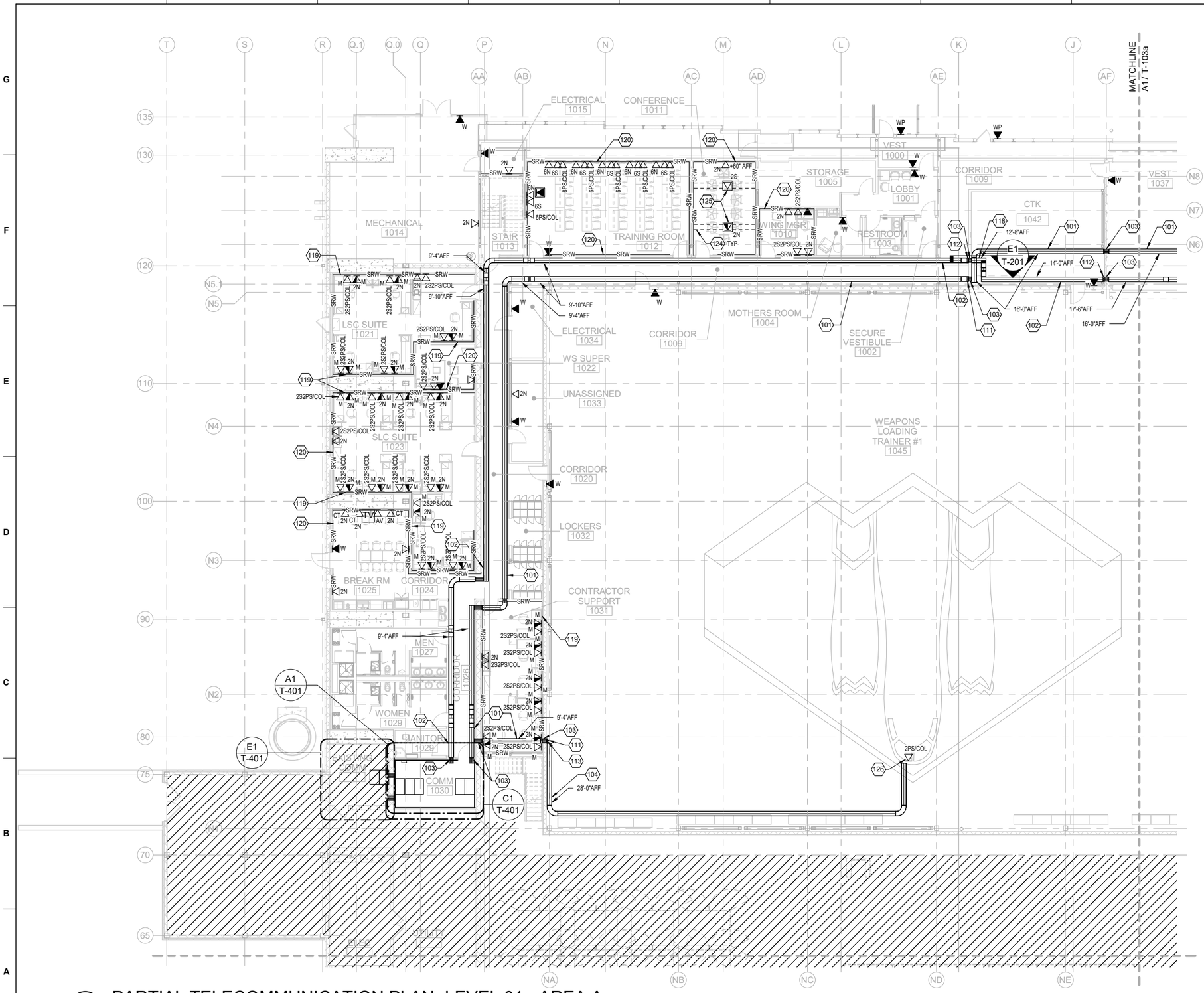
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER
TRAINING FACILITY
PROJECT NUMBER: FXBM231802
OVERALL TELECOMMUNICATIONS PLAN-
LEVEL 01

SHEET ID
T-101




A1 PARTIAL TELECOMMUNICATION PLAN- LEVEL 01 - AREA A

3/32" = 1'-0"

## GENERAL SHEET NOTES

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES REFER TO SHEET T-001.
2. REFER TO SHEET T-601 FOR PATHWAY ROUTING DETAILS.

## SHEET KEYNOTES

101 PROVIDE 12-INCH WIDE x 4-INCH DEEP UNCLASSIFIED BASKET TRAY.

102 PROVIDE 12-INCH WIDE x 4-INCH DEEP CLASSIFIED BASKET TRAY.

103 PROVIDE (2) 4-INCH SLEEVED CORES AND FIRESTOP UPON COMPLETION OF CONSTRUCTION TO MATCH FIRE RATING.

104 PROVIDE 12-INCH WIDE x 4-INCH DEEP UNCLASSIFIED BASKET TRAY TO NOSE CONE FOR COMMUNICATIONS CABLE.

111 PROVIDE 12-INCH WIDE X 4-INCH DEEP VERTICAL UNCLASSIFIED BASKET TRAY.

112 PROVIDE 12-INCH WIDE X 4-INCH DEEP VERTICAL CLASSIFIED BASKET TRAY.

113 CUT BASKET TRAY IN THIS AREA WHERE TRAY CLASHES WITH STRUCTURAL BEAM.

118 REFER TO ELEVATION, SHOWING THE SEPARATION BETWEEN CLASSIFIED AND UNCLASSIFIED TRAYS.

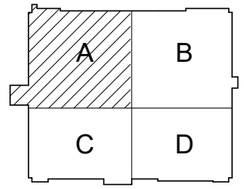
119 PROVIDE SURFACE RACEWAY WITH VENTED SIDEWALLS OF COVER PLATES FOR VIEWING SECURE CABLE ALONG THE ENTIRE RUN, (TRAY TO WORKSTATION) MOUNT 6-INCHES ABOVE THE MODULAR FURNITURE. THE CABLE WILL FEED DOWN INTO THE POWERED FURNITURE WHIP AT THE WALL-BASE. COORDINATE PATHWAY WITH MONITORS AND WHITEBOARD LOCATIONS.

120 PROVIDE SURFACE RACEWAY WITH VENTED SIDEWALLS OF COVER PLATES FOR VIEWING SECURE CABLE ALONG THE ENTIRE RUN, (TRAY TO OUTLETS) 18-INCHES ABOVE FINISHED FLOOR. THE CABLE WILL FEED INTO THE OUTLETS. COORDINATE PATHWAY WITH MONITORS AND WHITEBOARD LOCATIONS.

124 POWER WILL FEED FROM THE TROUGH FROM PLAN WEST; COMMUNICATIONS WILL FEED FROM THE PLANS EAST WALL TO SURFACE RACEWAY. REFER TO DETAIL ON T-503 FOR ADDITIONAL INFORMATION.

125 FLOOR MOUNTED BOXES REFER TO DETAILS ON T-502.

126 TERMINATE AND TEST PROGRAM SECURE COLLATERAL CABLE WITH THE NOSE CONE AREA. ALLOW 15-FEET OF CABLE SLACK AT THIS LOCATION FOR FUTURE MOUNTING TO THE WLT TRAINING MODULE (MOUNTING TO MODULE BY OTHERS).




AREA A
KEY PLAN

GRAPHIC SCALE

0 4' 8' 16' 32'

SCALE: 3/32"=1'-0"

PLAN NORTH

TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

DESIGNED BY: R. FAUVELLE
DRAWN BY: C. TINKER
CHECKED BY: M. ADKISON
SUBMITTED BY: B. DYSON

ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912DQ20R4035
CONTRACT NO.: W912DQ-20-R-4035
DRAWING CODE:
FILE NAME: FXBM231802T-102
ANSI D 22x34

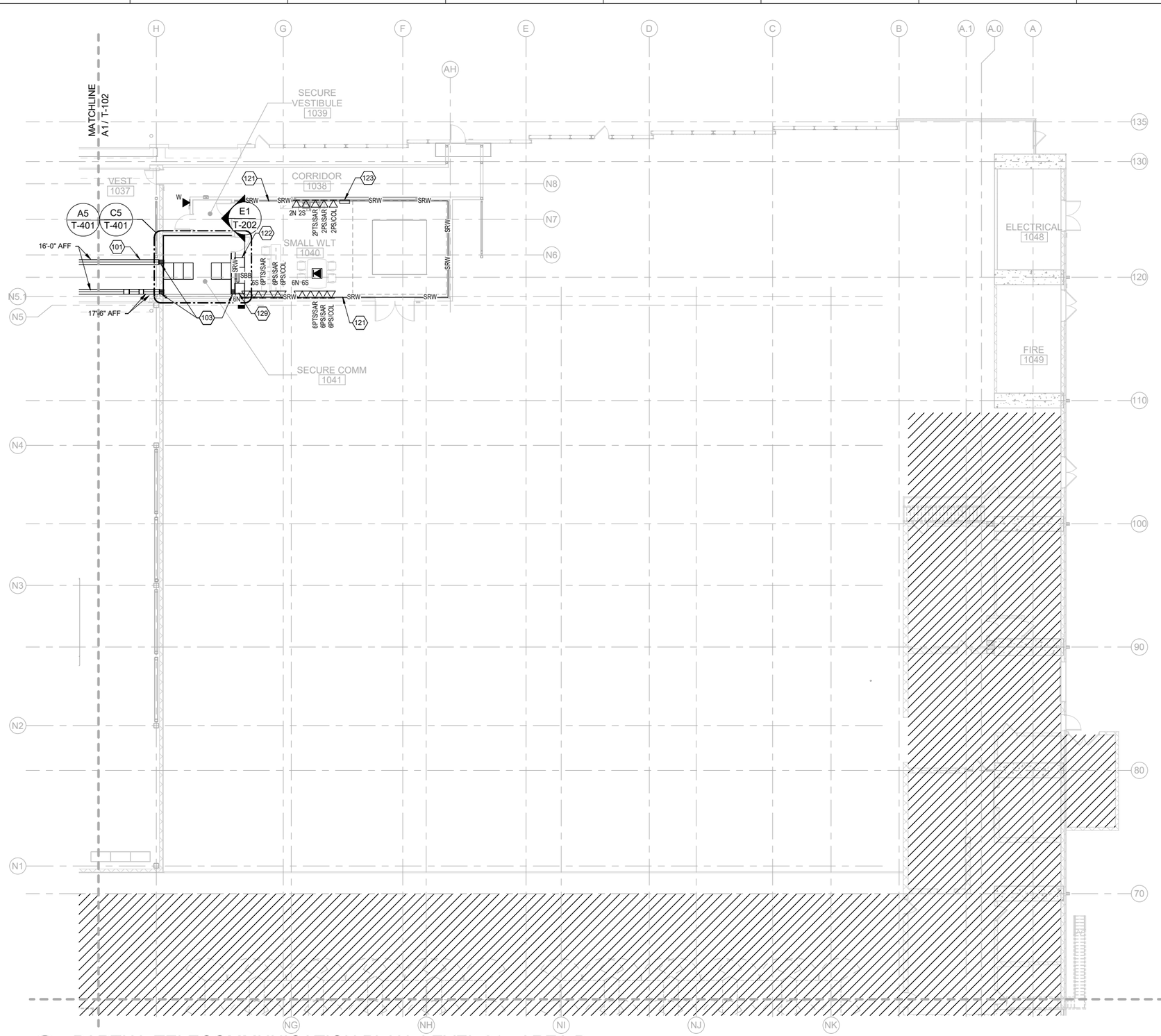
US ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
PARTIAL TELECOMMUNICATIONS PLAN - LEVEL 01 - AREA A

SHEET ID

T-102




A1 PARTIAL TELECOMMUNICATION PLAN- LEVEL 01 - AREA B

3/32" = 1'-0"

## GENERAL SHEET NOTES

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES REFER TO SHEET T-001.
2. REFER TO SHEET T-601 FOR PATHWAY ROUTING DETAILS.

## SHEET KEYNOTES

101 PROVIDE 12-INCH WIDE x 4-INCH DEEP UNCLASSIFIED BASKET TRAY.

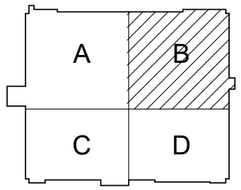
103 PROVIDE (2) 4-INCH SLEEVED CORES AND FIRESTOP UPON COMPLETION OF CONSTRUCTION TO MATCH FIRE RATING.

121 PROVIDE SURFACE RACEWAY FOR PROGRAM NETWORK CABLES. MOUNT SURFACE RACEWAY USING VENTED PARALLEL OPENINGS ON SIDEWALLS FOR VIEWING SECURE CABLE ALONG THE ENTIRE RUN, (CABINET TO OUTLETS). THE CABLE WILL FEED INTO THE OUTLETS.

122 PROVIDE CLASSIFIED WALL MOUNT CABINET FOR SIPR AND PROGRAM NETWORK EQUIPMENT, REFER TO T-202 FOR ADDITIONAL INFORMATION.

123 LOCATION OF SECURITY PANEL, REFER TO ELECTRONIC SECURITY SYSTEMS PLANS FOR ADDITIONAL INFORMATION.

129 PROVIDE WALL MOUNT CABINET FOR NIPR, REFER TO T-202 FOR ADDITIONAL INFORMATION.




AREA B
KEY PLAN

GRAPHIC SCALE

0 4' 8' 16' 32'

SCALE: 3/32"=1'-0"

PLAN NORTH

TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

DESIGNED BY: R. FAUVELLE
DRAWN BY: C. TINKER
CHECKED BY: M. ADKISON
SUBMITTED BY: B. DYSON
SIZE: ANSI D 22x34
ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912DQ20R4035
CONTRACT NO.: W912DQ-20-R-4035
DRAWING CODE:
FILE NAME: FXBM231802T-103a

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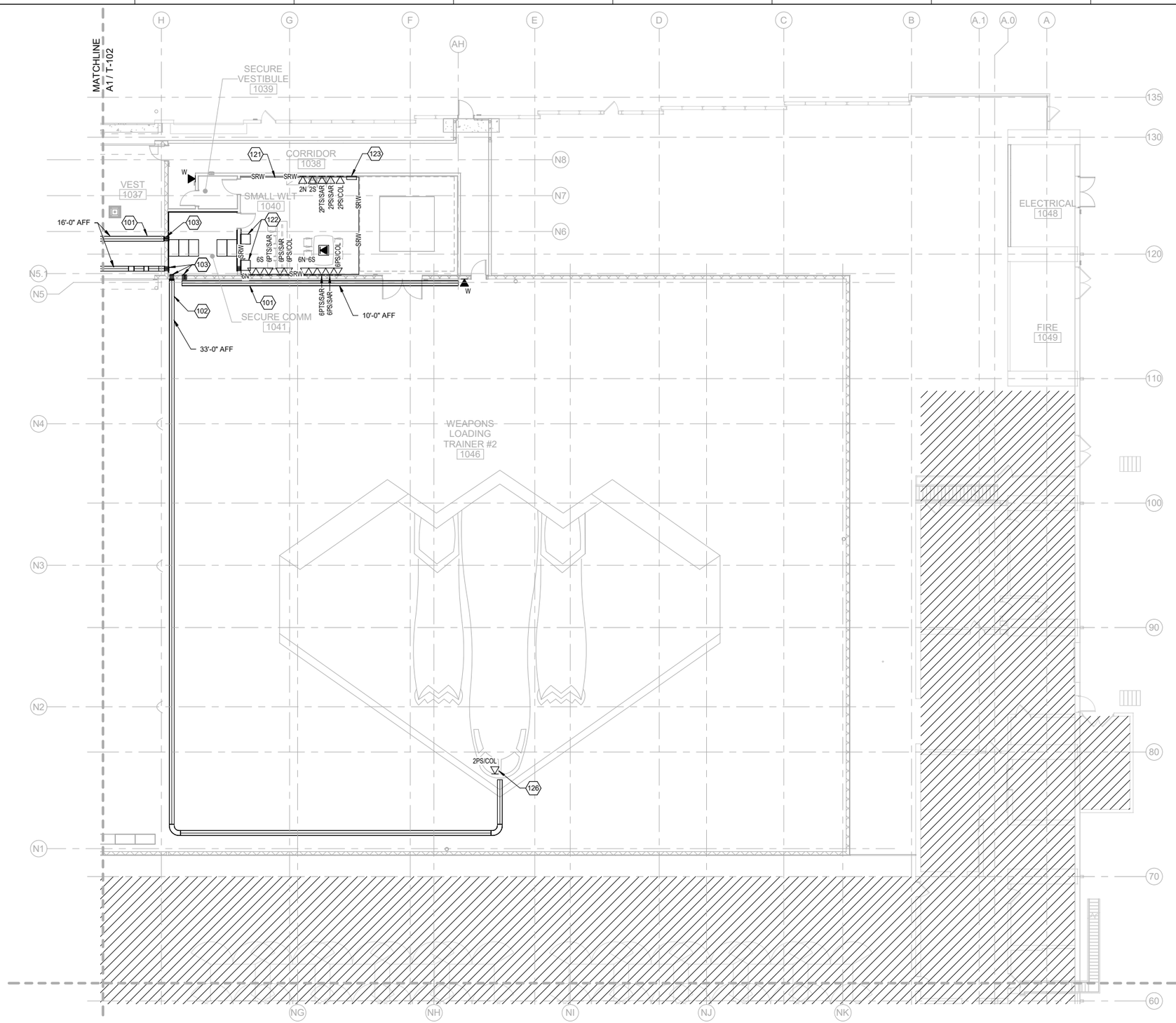
OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
PARTIAL TELECOMMUNICATIONS PLAN - LEVEL 01 - AREA B

SHEET ID

T-103a




# PARTIAL TELECOMMUNICATION PLAN- LEVEL 01 - AREA B - BID OPTION

A1 3/32" = 1'-0"

## GENERAL SHEET NOTES

1. FOR LEGEND, ABBREVIATIONS AND GENERAL NOTES REFER TO SHEET T-001.
2. REFER TO SHEET T-601 FOR PATHWAY ROUTING DETAILS.

## SHEET KEYNOTES

101 PROVIDE 12-INCH WIDE x 4-INCH DEEP UNCLASSIFIED BASKET TRAY.

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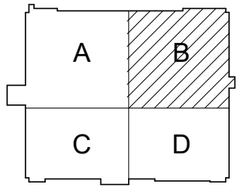
122 PROVIDE CLASSIFIED WALL MOUNT CABINET FOR SIPR AND PROGRAM NETWORK EQUIPMENT, REFER TO T-202 FOR ADDITIONAL INFORMATION.

123 LOCATION OF SECURITY PANEL, REFER TO ELECTRONIC SECURITY SYSTEMS PLANS FOR ADDITIONAL INFORMATION.

126 TERMINATE AND TEST PROGRAM SECURE COLLATERAL CABLE WITH THE NOSE CONE AREA. ALLOW 15-FEET OF CABLE SLACK AT THIS LOCATION FOR FUTURE MOUNTING TO THE WLT TRAINING MODULE (MOUNTING TO MODULE BY OTHERS).




AREA B
KEY PLAN

GRAPHIC SCALE

0 4' 8' 16' 32'

SCALE: 3/32"=1'-0"

PLAN NORTH

TRUE N

US Army Corps of Engineers
Omaha District ®

| MARK | DESCRIPTION | DATE |
|---|---|---|

DESIGNED BY: R. FAUVELLE
DRAWN BY: C. TINKER
CHECKED BY: M. ADKISON
SUBMITTED BY: B. DYSON
SIZE: ANSI D 22x34
ISSUE DATE: 9 MARCH 2023
SOLICITATION NO.: W912DQ20R4035
CONTRACT NO.: W912DQ-20-R-4035
DRAWING CODE:
FILE NAME: FXBM231802T-103b

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OMAHA DISTRICT
OMAHA, NEBRASKA

Jacobs
501 N. BROADWAY
ST. LOUIS, MISSOURI 63102

ELLSWORTH AIR FORCE BASE, SD
DESIGN B-21: WEAPONS LOADER TRAINING FACILITY
PROJECT NUMBER: FXBM231802
PARTIAL TELECOMMUNICATIONS PLAN - LEVEL 01 - AREA B - BID OPTION

SHEET ID
T-103b

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DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13 48 73

BRACING FOR MISCELLANEOUS EQUIPMENT

**05/22**

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1.2.2 Miscellaneous Equipment and Systems
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-- End of Section Table of Contents --

SECTION 13 48 73

BRACING FOR MISCELLANEOUS EQUIPMENT
**05/22**

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 |

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 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 |

METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)

MFMA-4 (2004) Metal Framing Standards Publication

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2019, with Change 1, 2022) Structural Engineering

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 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 UFC 4-010-01 additional data furnished by the Contracting Officer. Provide 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 without consideration of friction resulting from gravity loads.

### 1.2.2 Miscellaneous Equipment and Systems

Provide bracing and attachment for the following miscellaneous equipment and components developed by the Contractor in accordance with the requirements of this specification:
Equipment, utilities, and fixtures weighing 31 lbs or greater.

### 1.2.3 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 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 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 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-02 Shop Drawings

Bracing; G-AE

Equipment Requirements

SD-03 Product Data

Bracing; G-AE

Equipment Requirements

Anchor Bolts

Vibration Isolators

SD-05 Design Data

Design Calculations; G-AE

Anchor Bolts

## 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.

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 restraint and wind loads.

#### 2.1.1 Rigidly (Base and Suspended) Mounted Equipment

Equipment furnished under this contract must be rigidly mounted . 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.

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, Fp, must be doubled for vibration isolators with an air gap greater than 0.25 inches as specified in ASCE 7-16, 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.

## 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 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 EQUIPMENT SWAY BRACING

3.4.1 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.

3.4.2 Floor or Pad Mounted Equipment

3.4.2.1 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.

3.4.2.2 Overturning Resistance

Use the ratio of the overturning moment from 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.

-- End of Section --

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WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION
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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.

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 | (2021) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B16.4 | (2021) Gray Iron Threaded Fittings; Classes 125 and 250 |
| ASME B16.21 | (2021) Nonmetallic Flat Gaskets for Pipe Flanges |

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 | (2021) 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/ |

INTELLIGENCE COMMUNITY STANDARD (ICS)

| | |
|---|---|
| ICS 705-1 | (2010) Physical and Technical Security Standard for Sensitive Compartmented Information Facilities |

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

| | |
|---|---|
| MSS SP-71 | (2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 13 | (2022; ERTA 1 2021) Standard for the Installation of Sprinkler Systems |
| NFPA 24 | (2022) Standard for the Installation of Private Fire Service Mains and Their Appurtenances |
| NFPA 291 | (2022) 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 |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 199 | (2020) UL Standard for Safety Automatic Sprinklers for Fire-Protection Service |
| UL 312 | (2022) UL Standard for Safety Check Valves for Fire-Protection Service |
| UL Fire Prot Dir | (2012) Fire Protection Equipment Directory |

## 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 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 March 15, 2023 at Ellsworth AFB and resulted in a static pressure of 100 psi with a residual pressure of 84 psi while flowing 1,300 gpm. Perform a fire hydrant flow test prior to shop drawing submittal in accordance with NFPA 291. 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 noted in this paragraph, unless 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 the PRIDE Hangar, which is rated for 76 psi at 1,500 gpm. Calculations must be based on most recently available fire pump test data, if available.

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 of 500 gpm 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. 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. Working (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the QFPE. The QFPE must affix their professional engineering stamp with signature to the shop drawings, calculations, and material data sheets, 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.

e. Signing applicable certificates under SD-07.

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. 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 by the 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-AE

Sprinkler System Designer; G-AE

Sprinkler System Installer; G-AE

SD-02 Shop Drawings

Shop Drawing; G-AE

SD-03 Product Data

Steel Pipe; G-AE

Fittings; G-AE

Valves, including gate, check, butterfly, and globe; G-AE

Relief Valves; G-AE

Sprinklers; G-AE

Pipe Hangers and Supports; G-AE

Air Vent; G-AE

Nameplates; G-AE

SD-05 Design Data

Hydraulic Calculations; G-AE

SD-06 Test Reports

Test Procedures; G-AE

SD-07 Certificates

Verification of Compliant Installation; G-AE

Request for Government Final Test; G-AE

SD-10 Operation and Maintenance Data

Operating and Maintenance (O&M) Instructions

Spare Parts

SD-11 Closeout Submittals

As-built drawings; G-AE

## 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 the Contract Drawings. 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.

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 250 psi.

2.2 ABOVEGROUND PIPING COMPONENTS

2.2.1 Steel Piping Components

2.2.1.1 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.

2.2.1.2 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.

2.2.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings must be designed for not less than 250 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.

2.2.1.4 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.

2.2.2 Flexible Sprinkler Hose

The use of flexible hose is not permitted.

2.2.3 Pipe Hangers and Supports

Provide galvanized pipe hangers and supports in accordance with NFPA 13.

2.2.4 Valves

Provide valves of types approved for fire service. Valves must open by counterclockwise rotation.

2.2.4.1 Control Valve

Manually operated sprinkler control/gate valve must be outside stem and yoke (OS&Y) type or butterfly type and must be listed.

2.2.4.2 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 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. Extended coverage sprinklers are permitted for loading docks, residential occupancies and high-piled storage applications only. All sprinklers in light or ordinary hazard occupancies must be quick-response. All sprinklers in extra hazard occupancies must be standard-response.

### 2.3.1 Pendent Sprinkler

Pendent sprinkler must be with nominal K-factor as indicated on the drawings. Pendent sprinklers must have a polished chrome or white polyester finish. Assembly must include an integral escutcheon.

### 2.3.2 Upright Sprinkler

Upright sprinkler must be brass or white polyester and have a nominal K-factor as indicated on the drawings.

### 2.3.3 Sidewall Sprinkler

Sidewall sprinkler must have a nominal K-factor as indicated on the contract drawings. Sidewall sprinkler must have a brass polished-chrome or white polyester finish.

## 2.4 ACCESSORIES

### 2.4.1 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.

### 2.4.2 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.

### 2.4.3 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 within 7 feet of the floor or otherwise subject to mechanical damage.

### 2.4.4 Relief Valve

Relief valves must be listed and installed at the riser in accordance with NFPA 13.

### 2.4.5 Air Vent

Air vents must be of the automatic type and piped to drain to the building exterior.

### 2.4.6 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 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 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.

### 3.3.1 Protection of Piping Against Earthquake Damage

Seismic restraint is not required.

### 3.3.2 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.

### 3.3.3 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.

### 3.3.4 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 (plus or minus 2 inches).

e. 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.

### 3.3.5 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.

3.3.6 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.

3.3.7 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.

3.3.8 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 walls, fire partitions, or floors, pipes/sleeves must be firestopped in accordance with Section 07 84 00 FIRESTOPPING.

c. In penetrations that are not fire-rated or not a floor penetration, 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.

d. All penetrations through the boundary of rooms/areas identified as secure space area must meet ICS 705-1.

3.3.9 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.

3.3.10 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 at the location indicated. 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.

3.3.11 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.

3.4 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.

3.5 PAINTING

Color code mark piping as specified in 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 NICET Level III or IV 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.

3.6.2 Pre-Government Testing

3.6.2.1 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

3.6.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit a formal request for Government final test to the Contracting Officers Designated Representative (COR). Government final testing will not be scheduled until the COR 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.

3.6.3 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.

Government Final Tests will be witnessed by the Designated Fire Protection Engineer Contracting Officer, Qualified Fire Protection Engineer (QFPE). At this time, all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

## 3.7 MINIMUM SYSTEM TESTS

All newly installed system components must be tested to ensure that equipment and components function as intended. The aboveground interior piping systems and attached appurtenances subjected to system working pressure must be tested in accordance with NFPA 13 and NFPA 24.

### 3.7.1 Aboveground Piping

#### 3.7.1.1 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 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.

## 3.9 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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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 Z21.10.1/CSA 4.1 | (2019) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less |
| 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; R 2022) 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 A112.19.2/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 A112.19.5 | (2017) Flush Valves and Spuds for Water Closets, Urinals, and Tanks |
| 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 B16.15 | (2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250 |
| ASME B16.18 | (2021) Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.21 | (2021) Nonmetallic Flat Gaskets for Pipe Flanges |
| ASME B16.22 | (2021) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.50 | (2021) Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings |
| 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 CSD-1 | (2021) Control and Safety Devices for Automatically Fired Boilers |

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

| | |
|---|---|
| ASSE 1001 | (2021) Performance Requirements for Atmospheric Type Vacuum Breakers |
| ASSE 1003 | (2020) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010) |
| ASSE 1010 | (2021) Performance Requirements for Water Hammer Arresters |
| ASSE 1011 | (2017) Performance Requirements for Hose Connection Vacuum Breakers |
| ASSE 1012 | (2021) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent |
| ASSE 1013 | (2021) Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies |
| ASSE 1018 | (2001; R 2021) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002 |

| | |
|---|---|
| ASSE 1020 | (2020) Performance Requirements for Pressure Vacuum Breaker Assemblies |
| ASSE 1037 | (2015; R 2020) Performance Requirements for Pressurized Flushing Devices for Plumbing Fixtures |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA B300 | (2018) Hypochlorites |
| AWWA B301 | (2018) Liquid Chlorine |
| AWWA C606 | (2015) Grooved and Shouldered Joints |
| AWWA C651 | (2014) Standard for Disinfecting Water Mains |
| AWWA C652 | (2019) Disinfection of Water-Storage Facilities |

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 | (2021) Standard Specification for Cast Iron Soil Pipe and Fittings |
| ASTM A105/A105M | (2021) Standard Specification for Carbon Steel Forgings for Piping Applications |
| ASTM A183 | (2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts |
| 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 A733 | (2016) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples |

| | |
|---|---|
| ASTM A888 | (2021a) 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 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 B370 | (2022) Standard Specification for Copper Sheet and Strip for Building Construction |
| ASTM B584 | (2014; R 2022) Standard Specification for Copper Alloy Sand Castings for General Applications |
| ASTM B813 | (2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube |
| ASTM B828 | (2016) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings |
| 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 D2000 | (2018) Standard Classification System for Rubber Products in Automotive Applications |
| ASTM D2564 | (2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems |
| ASTM D2665 | (2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings |
| ASTM D2855 | (2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings |
| ASTM D3139 | (2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals |
| ASTM D3212 | (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 E1 | (2014) Standard Specification for ASTM Liquid-in-Glass Thermometers |
| ASTM F477 | (2014; R 2021) 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 |

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 |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC A117.1 | (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-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 250 | (2020) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| NEMA MG 1 | (2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31 |
| NEMA MG 11 | (1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 54 | (2021) National Fuel Gas Code |
| 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 | (2021) 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 499 | (2014; Reprint Jun 2022) UL Standard for Safety Electric Heating Appliances |
| UL 1951 | (2011; Reprint Jun 2020) UL Standard for Safety Electric Plumbing Accessories |

## 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-AE

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

Recycled Content for Cast Iron Pipe

Backflow Prevention Assemblies; G-AE

Shower Faucets; G-AE

WaterSense Label for Lavatory Faucet

Fixtures

List of installed fixtures with manufacturer, model, and flow rate.

Flush Valve Water Closets

WaterSense Label for Flush Valve Water Closet

Flush Valve Urinals

WaterSense Label for Urinal

Wall Hung Lavatories

Countertop Lavatories

Kitchen Sinks

Drinking-Water Coolers; G-AE

Energy Star Label for Electric Water Cooler

Energy Star Label for Wheelchair Electric Water Cooler

WaterSense Label for Showerhead

Water Heaters; G-AE

Energy Star Label for Gas Storage Water Heater

Pumps; G-AE

Vibration-Absorbing Features; G-AE

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

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-RO

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-RO

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 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with Section 26 42 13 GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM

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. 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." Pipe threads (except dry seal) shall conform to ASME B1.20.1. 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. 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.

2.1.1 Pipe Joint Materials

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. 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.

c. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5.

d. 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.

e. Solder Material: Solder metal shall conform to ASTM B32.

f. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

g. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.

h. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C564.

i. Rubber Gaskets for Grooved Pipe: ASTM D2000, maximum temperature 230 degrees F.

j. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.

k. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.

l. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D2564 and ASTM D2855.

m. 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.

n. Copper tubing shall conform to ASTM B88, Type K,or L.

2.1.2 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. Hose Clamps: SAE J1508.

d. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

e. Metallic Cleanouts: ASME A112.36.2M.

f. 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.

g. Hypochlorites: AWWA B300.

h. Liquid Chlorine: AWWA B301.

i. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

j. 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 |
| Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends | MSS SP-110 |
| Bronze Gate, Globe, Angle, and Check Valves | MSS SP-80 |

| | |
|---|---|
| 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 Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

### 2.3.2 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.

### 2.3.3 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

Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. 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 and pop-up stoppers of lavatory waste drains shall be copper alloy with all visible surfaces chrome plated.

### 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 Automatic Controls

Provide automatic, sensor operated faucets and flush valves to comply with ASSE 1037 and UL 1951 for lavatory faucets, urinals, and water closets. Flushing and faucet systems shall consist of solenoid-activated valves with light beam sensors. Flush valve for water closet shall include an override pushbutton. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

### 2.4.3 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 solenoid-activated flush valves including electrical-operated light-beam-sensor to energize

the solenoid.

2.4.4 Flush Valve Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 17 inches above the floor. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 0.125 gallons per flush. Urinals must meet the specifications of http://www.epa.gov/watersense/partners/product_program_specs.html and must be EPA WaterSense labeled products. Provide data identifying WaterSense label for urinal. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports. 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. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.5 Wheelchair Flush Valve Type Urinals

ASME A112.19.2/CSA B45.1, white vitreous china, wall-mounted, wall outlet, blowout action, integral trap, elongated projecting bowl, and ASME A112.19.5 trim. Provide large diaphragm (not less than 2.625 inches upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers), nonhold-open flush valve of chrome plated cast brass conforming to ASTM B584, including vacuum breaker and angle (control-stop) valve with back check. The water flushing volume of the flush valve and urinal combination shall not exceed 0.125 gallon per flush. Urinals must meet the specifications of http://www.epa.gov/watersense/partners/product_program_specs.html and must be EPA WaterSense labeled products. Provide data identifying WaterSense label for wheelchair flush valve urinal. Furnish urinal manufacturer's certification of conformance. Provide ASME A112.6.1M concealed chair carriers. Mount urinal with front rim a maximum of 17 inches above floor and flush valve handle a maximum of 44 inches above floor for use by handicapped on wheelchair. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.6 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 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 solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.

2.4.7 Countertop Lavatories

ASME A112.19.2/CSA B45.1, white vitreous china, self-rimming, minimum dimensions of 19 inches wide by 17 inches front to rear, with supply

openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Mount counter with the top surface 34 inches above floor and with 29 inches minimum clearance from bottom of the counter face to floor. Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.

2.4.8 Kitchen Sinks

ASME A112.19.3/CSA B45.4, 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions of 33 inches wide by 21 inches front to rear, two compartments, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink faucets with hose spray, and with 3.5 inch drain outlet. Water flow rate shall not exceed 2.2 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 and drain piping to vertical vent piping from each compartment. Provide top mounted washerless sink faucets with hose spray.

2.4.9 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.

2.4.10 Wheelchair Drinking 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.

2.4.11 Precast Terrazzo Shower Floors

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.

2.4.12 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.

2.4.13 Emergency Eye and Face Wash

ANSI/ISEA Z358.1, wall-mounted self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor. Unit shall deliver 5 gpm of aerated water at 30 psig flow pressure, with eye and face wash nozzles 33 to 45 inches above finished floor. Provide copper alloy control valves. Provide an air-gap with the lowest potable eye and face wash water outlet located above the overflow rim by not less than the International Plumbing Code minimum. Provide a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 60 to 95 degrees F. Provide packaged, UL listed, alarm system; including an amber strobe lamp, horn with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow service within NEMA Type 3 or 4 enclosures.

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 be 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 DRAINS

2.6.1 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.

### 2.6.2 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 (1.50 gpm). Provide data identifying WaterSense label for showerhead. Provide separate globe valves or angle valves with union connections in each supply to faucet.

### 2.6.3 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3.

### 2.6.4 Floor Sinks

Floor sinks shall be square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, ABS sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

## 2.7 TRAPS

Unless otherwise specified, traps shall be copper-alloy adjustable tube type with slip joint inlet and swivel. 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.

## 2.8 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 120 to 180 degrees F. 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. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. 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.

2.8.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.

2.8.1.1 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1/CSA 4.1 when input is 75,000 BTU per hour or less or ANSI Z21.10.3/CSA 4.3 for heaters with input greater than 75,000 BTU per hour. Provide Energy Star labeled gas storage water heater. Provide data identifying Energy Star label for gas storage water heater.

2.8.2 Electric Instantaneous Water Heaters (Tankless)

UL 499 and UL listed flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

2.9 PUMPS

2.9.1 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor shall be close-coupled with an overhung impeller, or supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover.

Integral size motors shall be premium efficiency type in accordance with NEMA MG 1. Pump motors smaller than 1 hp Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

2.10 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 high efficiency type, 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. 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.

## 2.11 MISCELLANEOUS PIPING ITEMS

### 2.11.1 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.

### 2.11.2 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.

#### 2.11.2.1 Sleeves in Masonry and Concrete

Provide steel 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.

#### 2.11.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

### 2.11.3 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. Provide Type 40 insulation protection shield for insulated piping.

2.11.4 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.

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. 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 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or

equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 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.

3.1.1.4 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.

3.1.1.5 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.

3.1.1.6 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.

3.1.1.7 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.

3.1.1.8 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 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.

3.1.2.1 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.

3.1.2.2 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.

3.1.2.3 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.

3.1.2.4 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.

3.1.2.5 Plastic Pipe

PVC 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 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.

3.1.4 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.4.1 Sleeve Requirements

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

a. Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

b. 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.

c. 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.

d. 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.

e. 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.

f. 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 concrete 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.

3.1.4.2 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.

3.1.4.3 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.

3.1.4.4 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, 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.

3.1.4.5 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.5 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.

3.1.6 Supports

3.1.6.1 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.

3.1.6.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Section 13 48 73 BRACING FOR MISCELLANEOUS EQUIPMENT and Section 23 05 48.19 SEISMIC BRACING FOR HVAC. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05 12 00 STRUCTURAL STEEL.

3.1.6.3 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 pipe shall be 120 degrees F for PVC. 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 that 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.

3.1.6.4 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.

3.1.7 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 AND HOT WATER STORAGE TANKS

### 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 Installation of Gas-Fired Water Heater

Installation shall conform to NFPA 54 for gas fired. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

### 3.2.3 Heat Traps

Piping to and from each water heater and hot water storage tank shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

### 3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

### 3.2.5 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.

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.

3.3.4 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.

3.3.4.1 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.

3.3.4.2 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.

3.3.4.3 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.

3.3.4.4 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.

3.3.5 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.

3.3.6 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.

3.3.7 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.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including compressors and pumps, shall be isolated

from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors.

## 3.5 IDENTIFICATION SYSTEMS

### 3.5.1 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.

### 3.5.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.5.3 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. The color code system shall be as indicated below and coordinated with the base standard.

| Color | System | Item | Location |
|---|---|---|---|
| _____ | _____ | _____ | _____ |

## 3.6 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.

## 3.7 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.

### 3.7.1 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.

#### 3.7.1.1 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.

#### 3.7.1.2 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.

## 3.8 TESTS, FLUSHING AND DISINFECTION

### 3.8.1 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.

#### 3.8.1.1 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.

3.8.2 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.

3.8.3 System Flushing

3.8.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with 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.

3.8.3.2 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.

3.8.4 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.

3.8.5 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 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.

## 3.10 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)

### 3.10.1 Storage Water Heaters

#### 3.10.1.1 Gas

a. Storage capacity of 50 gallons or less shall have a minimum energy factor (EF) of 0.67 or higher per FEMP requirements.

b. Storage capacity of 20 gallons - or more and input rating of 75,000 Btu/h or less: minimum EF shall be 0.62 - 0.0019V per 10 CFR 430.

c. Rating of less than 22980 W: (75,000 Btu/h) ET shall be 80 percent; maximum SL shall be (Q/800+110x(V^^1/2)), per ANSI Z21.10.3/CSA 4.3

3.11 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 | SERVICE F | SERVICE G |
|---|---|---|---|---|---|---|---|---|
| 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 | 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 | | | |
| 20 | Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D2665, ASTM F891, (Sch 40) ASTM F1760 | X | X | | X | | | X |

SERVICE:

A - Underground Building Soil, Waste and Storm Drain
B - Aboveground Soil, Waste, Drain In Buildings
C - Underground Vent
D - Aboveground Vent
E - Interior Rainwater Conductors Aboveground
F - Corrosive Waste And Vent Above And Belowground
G - Condensate Drain Aboveground

* - Hard Temper

TABLE II

PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

| Item # | Pipe and Fitting Materials | SERVICE A | SERVICE B | SERVICE C | SERVICE D |
|---|---|---|---|---|---|
| 8 | Seamless copper water tube, ASTM B88, ASTM B88M | 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 |
|---|---|---|---|---|---|
| 9 | Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7 | X | X | | X |
| 10 | Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8 | X | X | | X |
| 11 | Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 8 | X | X | | X |
| 33 | Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828 | X | X | | |
| 36 | Nipples, pipe threaded ASTM A733 | X | X | | |
| | SERVICE:<br>A - Cold Water Service Aboveground<br>B - Hot and Cold Water Distribution<br>180 degrees F Maximum Aboveground<br>C - Compressed Air Lubricated<br>D - Cold Water Service Belowground<br>Indicated types are minimum wall thicknesses.<br>** - Type L - Hard<br>*** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors<br>**** - In or under slab floors only brazed joints | | | | |

TABLE III

STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

| FUEL | STORAGE CAPACITY GALLONS | INPUT RATING | TEST PROCEDURE | REQUIRED PERFORMANCE |
|---|---|---|---|---|
| A. STORAGE WATER HEATERS | | | | |
| Gas | 1,000 (Btu/h)/gal max. | Btu/h RE: Plumb Drawings | ANSI Z21.10.3/CS | ET = 80 percent min. SL = 1.3+38/V max. |

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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COMMON PIPING FOR HVAC

**05/22**

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COMMON PIPING FOR HVAC
**05/22**

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 |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME A112.18.1/CSA B125.1 | (2018) Plumbing Supply Fittings |
| 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 B1.20.7 | (1991; R 2013) Standard for Hose Coupling Screw Threads (Inch) |
| ASME B16.1 | (2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250 |
| ASME B16.3 | (2021) 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 B16.22 | (2021) 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 B31.3 | (2020) Process Piping |
| ASME B40.100 | (2013) Pressure Gauges and Gauge Attachments |
| ASME BPVC SEC IX | (2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.8/A5.8M | (2019) Specification for Filler Metals for Brazing and Braze Welding |
| AWS WHB-2.9 | (2004) Welding Handbook; Volume 2, Welding Processes, Part 1 |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A6/A6M | (2021) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling |
| ASTM A53/A53M | (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A126 | (2004; R 2019) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings |
| ASTM A197/A197M | (2000; R 2019) Standard Specification for Cupola Malleable Iron |
| ASTM A234/A234M | (2019) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service |
| ASTM A307 | (2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength |
| ASTM A312/A312M | (2021) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes |
| ASTM A480/A480M | (2020a) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip |
| ASTM A563 | (2015) Standard Specification for Carbon and Alloy Steel Nuts |
| ASTM B32 | (2020) Standard Specification for Solder Metal |
| ASTM B62 | (2017) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B88 | (2020) Standard Specification for Seamless Copper Water Tube |
| ASTM B117 | (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus |
| ASTM B370 | (2022) Standard Specification for Copper |

| | |
|---|---|
| | Sheet and Strip for Building Construction |
| ASTM B749 | (2020) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products |
| ASTM C67/C67M | (2021) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile |
| ASTM C109/C109M | (2021) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) |
| ASTM C404 | (2018) Standard Specification for Aggregates for Masonry Grout |
| ASTM C476 | (2020) Standard Specification for Grout for Masonry |
| ASTM C553 | (2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications |
| ASTM C920 | (2018) Standard Specification for Elastomeric Joint Sealants |
| ASTM E1 | (2014) Standard Specification for ASTM Liquid-in-Glass Thermometers |
| ASTM E814 | (2013a; R 2017) Standard Test Method for Fire Tests of Penetration Firestop Systems |
| ASTM F104 | (2011; R 2020) Standard Classification System for Nonmetallic Gasket Materials |

FLUID SEALING ASSOCIATION (FSA)

| | |
|---|---|
| FSA-0017 | (1995e6) Standard for Non-Metallic Expansion Joints and Flexible Pipe Connectors Technical 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-70 | (2011) Gray Iron Gate Valves, Flanged and Threaded Ends |
| 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-125 | (2010) Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| MIL-C-18480 | (1982; Rev B; Notice 2 2009) Coating Compound, Bituminous, Solvent, Coal-Tar Base |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| CID A-A-1922 | (Rev A; Notice 3) Shield, Expansion (Caulking Anchors, Single Lead) |
| 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) |
| CID A-A-55614 | (Basic; Notice 2) Shield, Expansion (Non-Drilling Expansion Anchors) |
| CID A-A-55615 | (Basic; Notice 3) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1479 | (2015; Reprint May 2021) Fire Tests of Through-Penetration Firestops |

1.2 GENERAL REQUIREMENTS

Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section

Submit Records of Existing Conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of the existing conditions.

Submit Fabrication Drawings for pipes, valves and specialties consisting of fabrication and assembly details to be performed in the factory.

Submit Material, Equipment, and Fixture Lists for pipes, valves and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. Provide a complete list of construction equipment to be used.

Include with Listing of Product Installations for piping systems 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. Include in the list purchaser, address of installation, service

organization, and date of installation.

Submit Record Drawings for pipes, valves and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

Submit Connection Diagrams for pipes, valves and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Coordination Drawings for pipes, valves and specialties showing coordination of work between different trades and with the structural and architectural elements of work. Detail all drawings sufficiently to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate on drawings where conflicts or clearance problems exist between various trades.

## 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

Material, Equipment, and Fixture Lists; G-RO

SD-02 Shop Drawings

Record Drawings; G-AE

Connection Diagrams; G-AE

Coordination Drawings; G-AE

Fabrication Drawings; G-AE

Installation Drawings; G-AE

SD-03 Product Data

Pipe and Fittings; G-AE

Piping Specialties; G-AE

Valves; G-AE

Miscellaneous Materials; G-AE

Supporting Elements; G-AE

SD-05 Design Data

Pipe and Fittings; G-RO

Piping Specialties; G-RO

Valves; G-RO

SD-06 Test Reports

Hydrostatic Tests; G-RO

Air Tests; G-RO

Valve-Operating Tests; G-RO

Drainage Tests; G-RO

Pneumatic Tests; G-RO

Non-Destructive Electric Tests; G-RO

System Operation Tests; G-RO

SD-07 Certificates

Record of Satisfactory Field Operation G-RO

List of Qualified Permanent Service Organizations; G-RO

Listing of Product Installations; G-RO

Records of Existing Conditions; G-RO

Surface Resistance; G-RO

Shear and Tensile Strengths; G-RO

Temperature Ratings; G-RO

Bending Tests; G-RO

Flattening Tests; G-RO

Transverse Guided Weld Bend Tests; G-RO

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G-RO

## 1.4 QUALITY ASSURANCE

### 1.4.1 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. Provide standard products 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. Ensure the product has been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2 Alternative Qualifications

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 or laboratory tests, can be shown.

1.4.3 Service Support

Ensure the equipment items are supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. Select service organizations that are 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.

1.4.4 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.

1.4.5 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.

1.4.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions are considered mandatory, the word "should" is interpreted as "shall." Reference to the "code official" is interpreted to mean the "Contracting Officer." For Navy owned property, interpret references to the "owner" to mean the "Contracting Officer." For leased facilities, references to the "owner" is interpreted to mean the "lessor." References to the "permit holder" are interpreted to mean the "Contractor."

1.4.5.2 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, are applied as appropriate by the Contracting Officer and as authorized by his administrative cognizance and the FAR.

1.5 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.

1.6 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Ensure motors, controllers, disconnects and contactors 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 is not permitted. Provide controllers and contactors with 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, include the cost of additional electrical service and related work under the section that specified that motor or equipment. Provide power wiring and conduit for field installed equipment under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.7 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

2.1 PIPE AND FITTINGS

Submit equipment and performance data for pipe and fittings consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.1.1 Type BCS, Black Carbon Steel

Ensure pipe 1/8 through 12 inches is Schedule 40 black carbon steel, conforming to ASTM A53/A53M.

Ensure fittings 2 inches and under are 150-pounds per square inch, gage (psig) working steam pressure (wsp) banded black malleable iron screwed, conforming to ASTM A197/A197M and ASME B16.3.

Ensure unions 2 inches and under are 250 pounds per square inch, wsp female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to ASME B16.39.

Ensure fittings 2-1/2 inches and over are Steel butt weld, conforming to ASTM A234/A234M and ASME B16.9 to match pipe wall thickness.

Ensure flanges 2-1/2 inches and over are 150-pound forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

2.1.2 Type GCS-DWV, Galvanized Steel Drain, Waste and Vent

Ensure pipe (all sizes) is Schedule 40 seamless galvanized carbon steel, conforming to ASTM A53/A53M, Grade A.

Furnace butt weld pipe is acceptable for sizes less than 2 inches.

Provide risers 3 inches and larger are Type CISP-DWV.

Ensure fittings are galvanized, coated, screwed, cast iron, recessed pattern drainage fittings, conforming to ASTM A126.

Use long radius fittings wherever space permits. Short-turn tees, branches, and ells may be used for vent piping and connections of branch lines to battery fixtures, except wall-hung water closets.

2.1.3 Type CPR, Copper

2.1.3.1 Type CPR-A, Copper Above Ground

Ensure tubing 2 inches and under is seamless copper tubing, conforming to ASTM B88, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Ensure fittings 2 inches and under are 150-psig wsp wrought-copper solder joint fittings conforming to ASME B16.22.

Ensure unions 2 inches and under are 150-psig wsp wrought-copper solder joint, conforming to ASME B16.22.

Provide brazing rod with Classification BCuP-5, conforming to AWS A5.8/A5.8M.

Use solder, alloy Sb-5, conforming to ASTM B32.

2.2 PIPING SPECIALTIES

Submit equipment and performance data for piping specialties consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.2.1 Air Vents

Provide manual air vents using 3/8-inch globe valves.

Provide automatic air vents on pumps, mains, and where indicated using ball-float construction. Ensure the vent inlet is not less than 3/4-inch ips and the outlet not less than 1/4-inch ips. Orifice size is 1/8 inch. Provide corrosion-resistant steel trim conforming to ASTM A480/A480M. Fit vent with try-cock. Ensure vent discharges air at any pressure up to 150 psi. Ensure outlet is copper tube.

2.2.2 Dielectric Connections

Electrically isolate dissimilar pipe metals from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.2.3 Expansion Vibration Isolation Joints

Construct single or multiple arch-flanged expansion vibration isolation joints of steel-ring reinforced chloroprene-impregnated cloth materials. Design joint to absorb the movement of the pipe sections in which installed with no detrimental effect on the pipe or connected equipment. Back flanges with ferrous-metal backing rings. Provide control rod assemblies to restrict joint movement. Coat all nonmetallic exterior surfaces of the joint with chlorosulphonated polyethylene. Provide grommets in limit bolt hole to absorb noise transmitted through the bolts.

Ensure joints are suitable for continuous-duty working temperature of at least 250 degrees F.

Fill arches with soft chloroprene.

Ensure joint, single-arch, movement limitations and size-related, pressure characteristics conform to FSA-0017.

2.2.4 Flexible Pipe

Construct flexible pipe vibration and pipe-noise eliminators of wire-reinforced, rubber-impregnated cloth and cord materials and be flanged. Back the flanges with ferrous-metal backing rings. Ensure service pressure-rating is a minimum 1.5 times actual service, with surge pressure at 180 degrees F.

Construct flexible pipe vibration and pipe noise eliminators of wire-reinforced chloroprene-impregnated cloth and cord materials. Ensure the pipe is flanged. Provide all flanges backed with ferrous-metal backing rings. Coat nonmetallic exterior surfaces of the flexible pipe with an acid- and oxidation-resistant chlorosulphonated polyethylene. Rate the flexible pipe for continuous duty at 130 psi and 250 degrees F.

Ensure unit pipe lengths, face-to-face, are not less than the following:

| INSIDE DIAMETER | UNIT PIPE LENGTH |
|---|---|
| To 3 inches, inclusive | 18 inches |
| 4 to 10 inches, inclusive | 24 inches |

2.2.5 Flexible Metallic Pipe

Ensure flexible pipe is the bellows-type with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Minimum working pressure rating is 100 psi at 300 degrees F.

Ensure minimum burst pressure is four times working pressure at 300 degrees F. Bellows material is AISI Type 316L corrosion-resistant steel.

Ensure braid is AISI 300 series corrosion-resistant steel wire.

Provide threaded end connections; hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A312/A312M.

2.2.6 Hose Faucets

Construct hose faucets with 1/2 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection, conforming to ASME A112.18.1/CSA B125.1. Ensure hose-coupling screw threads conform to ASME B1.20.7.

Provide vandal proof, atmospheric-type vacuum breaker on the discharge of all potable water lines.

2.2.7 Pressure Gages

Ensure pressure gages conform to ASME B40.100 and to requirements specified herein. Pressure-gage size is 3-1/2 inches nominal diameter. Ensure case is corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A6/A6M, with an ASM No. 4 standard commercial polish or better. Equip gages with adjustable red marking pointer and damper-screw adjustment in inlet connection. Align service-pressure reading at midpoint of gage range. Ensure all gages are Grade B or better and be equipped with gage isolators.

2.2.8 Sight-Flow Indicators

Construct sight-flow indicators for pressure service on 3-inch ips and smaller of bronze with specially treated single- or double-glass sight windows and have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on an AISI Type 304 corrosion-resistant steel shaft. Body may have screwed or flanged end. Provide pressure- and temperature-rated assembly for the applied service. Flapper flow-type indicators are not acceptable.

2.2.9 Sleeve Couplings

Sleeve couplings for plain-end pipe consist of one steel middle ring, two steel followers, two chloroprene or Buna-N elastomer gaskets, and the necessary steel bolts and nuts.

2.2.10 Thermometers

Ensure thermometers conform to ASTM E1, except for being filled with a red organic liquid. Provide an industrial pattern armored glass thermometer, (well-threaded and seal-welded). Ensure thermometers installed 6 feet or higher above the floor have an adjustable angle body. Ensure scale is not less than 7 inches long and the case face is manufactured from manufacturer's standard polished aluminum or AISI 300 series polished corrosion-resistant steel. Provide thermometers with nonferrous separable wells. Provide lagging extension to accommodate insulation thickness.

2.2.11 Pump Suction Strainers

Provide a cast iron strainer body, rated for not less than 25 psig at 100 degrees F, with flanges conforming to ASME B16.1, Class 125. Strainer construction is such that there is a machined surface joint between body and basket that is normal to the centerline of the basket.

Ensure minimum ratio of open area of each basket to pipe area is 3 to 1. Provide a basket with AISI 300 series corrosion-resistant steel wire mesh with perforated backing.

Ensure mesh is capable of retaining all particles larger than 1,000 micrometer, with a pressure drop across the strainer body of not more than 0.5 psi when the basket is two-thirds dirty at maximum system flow rate. Provide reducing fittings from strainer-flange size to pipe size.

Provide a pressure gage with 0.25-pound graduations fitted with a two-way brass cock across the strainer.

Provide manual air vent cocks in cap of each strainer.

### 2.2.12 Line Strainers, Water Service

Provide Y-type strainers with removable basket. Ensure strainers in sizes 2-inch ips and smaller have screwed ends; in sizes 2-1/2-inch ips and larger, strainers have flanged ends. Ensure body working-pressure rating exceeds maximum service pressure of installed system by at least 50 percent. Ensure body has cast-in arrows to indicate direction of flow. Ensure all strainer bodies fitted with screwed screen retainers have straight threads and gasketed with nonferrous metal. For strainer bodies 2-1/2-inches and larger, fitted with bolted-on screen retainers, provide offset blowdown holes. Fit all strainers larger than 2-1/2-inches with manufacturer's standard ball-type blowdown valve. Ensure body material is cast bronze conforming to ASTM B62. Where system material is nonferrous, use nonferrous metal for the metal strainer body material.

Ensure minimum free-hole area of strainer element is equal to not less than 3.4 times the internal area of connecting piping. Strainer screens perforation size is not to exceed 0.045-inch. Ensure strainer screens have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material is AISI Type 304 corrosion-resistant steel.

## 2.3 VALVES

Submit equipment and performance data for valves consisting of corrosion resistance and life expectancy. Submit design analysis and calculations consisting of rates of flow, head losses, inlet and outlet design, and pressure calculations. Also include in data, pipe dimensions, as well as temperature ratings, vibration and thrust limitations, minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

### 2.3.1 Ball and Butterfly Valves

Ensure ball valves conform to MSS SP-72 for flanged valves and are rated for service at not less than 175 psig at 200 degrees F. For valve bodies in sizes 2 inches and smaller, use screwed-end connection-type constructed of Class A copper alloy. For valve bodies in sizes 2-1/2 inches and larger, use flanged-end connection type, constructed of Class D material. Balls and stems of valves 2 inches and smaller are manufacturer's standard with hard chrome plating finish. Balls and stems of valves 2-1/2 inches and larger are manufacturer's standard Class C corrosion-resistant steel alloy with hard chrome plating. Balls of valves 6 inches and larger may be Class D with 900 Brinell hard chrome plating. Ensure valves are suitable for flow from either direction and seal equally tight in either direction. Valves with ball seals held in place by spring washers are not

acceptable. Ensure all valves have adjustable packing glands. Seats and seals are fabricated from tetrafluoroethylene.

Ensure butterfly valves conform to MSS SP-67 and are the wafer type for mounting between specified flanges. Ensure valves are rated for 150-psig shutoff and nonshock working pressure. Select bodies of cast ferrous metal conforming to ASTM A126, Class B, and to ASME B16.1 for body wall thickness. Seats and seals are fabricated from resilient elastomer designed for field removal and replacement.

2.3.2 Drain, Vent, and Gage Cocks

Provide lever handle drain, vent, and gage cocks, ground key type, with washer and screw, constructed of polished ASTM B62 bronze, and rated 125-psi wsp. Ensure end connections are rated for specified service pressure.

Ensure pump vent cocks, and where spray control is required, are UL umbrella-hood type, constructed of manufacturer's standard polished brass. Ensure cocks are 1/2-inch ips male, end threaded, and rated at not less than 125 psi at 225 degrees F.

2.3.3 Gate Valves (GAV)

Ensure gate valves 2 inches and smaller conform to MSS SP-80. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated use union-ring bonnet, screwed-end type. Make packing of non-asbestos type materials. Use rising stem type valves.

Ensure gate valves 2-1/2 inches and larger, are Type I, (solid wedge disc, tapered seats, steam rated); Class 125 (125-psig steam-working pressure at 353 degrees F saturation); and 200-psig, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Select flanged valves, with bronze trim and outside screw and yoke (OS&Y) construction. Make packing of non-asbestos type materials.

2.3.4 Globe and Angle Valves (GLV-ANV)

Ensure globe and angle valves 2 inches and smaller, are 125-pound, 125-psi conforming to MSS SP-80 and to requirements specified herein. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated, use union-ring bonnet, screwed-end type. Ensure disc is free to swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Make packing of non-asbestos type materials. Ensure disk and packing are suitable for pipe service installed.

Ensure globe and angle valves, 2-1/2 inches and larger, are cast iron with bronze trim. Ensure valve bodies are cast iron conforming to ASTM A126, Class A, as specified for Class 1 valves under MSS SP-80. Select flanged valves in conformance with ASME B16.1. Valve construction is outside screw and yoke (OS&Y) type. Make packing of non-asbestos type materials.

2.3.5 Standard Check Valves (SCV)

Ensure standard check valves in sizes 2 inches and smaller are 125-psi swing check valves except as otherwise specified. Provide lift checks where indicated. Ensure swing-check pins are nonferrous and suitably hard for the service. Select composition type discs. Ensure the swing-check

angle of closure is manufacturer's standard unless a specific angle is needed.

Use cast iron, bronze trim, swing type check valves in sizes 2-1/2 inches and larger. Ensure valve bodies are cast iron, conforming to ASTM A126, Class A and valve ends are flanged in conformance with ASME B16.1. Swing-check pin is AISI Type or approved equal corrosion-resistant steel. Angle of closure is manufacturer's standard unless a specific angle is needed. Ensure valves have bolted and gasketed covers.

Provide check valves with external spring-loaded, positive-closure devices and valve ends are mechanical joint flanged.

2.3.6 Nonslam Check Valves (NSV)

Provide check valves at pump discharges in sizes 2 inches and larger with nonslam or silent-check operation conforming to MSS SP-125. Select a valve disc or plate that closes before line flow can reverse to eliminate slam and water-hammer due to check-valve closure. Ensure valve is Class 125 rated for 200-psi maximum, nonshock pressure at 150 degrees F in sizes to 12 inches. Use valves that are wafer type to fit between flanges conforming to ASME B16.1 fitted with flanges conforming to ASME B16.1. Valve body may be cast iron, or equivalent strength ductile iron. Select disks using manufacturer's standard bronze, aluminum bronze, or corrosion-resistant steel. Ensure pins, springs, and miscellaneous trim are manufacturer's standard corrosion-resistant steel. Disk and shaft seals are Buna-N elastomer tetrafluoroethylene.

2.4 MISCELLANEOUS MATERIALS

Submit equipment and performance data for miscellaneous materials consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

2.4.1 Bituminous Coating

Ensure the bituminous coating is a solvent cutback, heavy-bodied material to produce not less than a 12-mil dry-film thickness in one coat, and is recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.

For previously coal-tar coated and uncoated ferrous surfaces underground, use bituminous coating solvent cutback coal-tar type, conforming to MIL-C-18480.

2.4.2 Bolting

Ensure flange and general purpose bolting is hex-head and conforms to ASTM A307, Grade B (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts conform to ASTM A563. Square-head bolts and nuts are not acceptable. Ensure threads are coarse-thread series.

2.4.3 Elastomer Caulk

Use two-component polysulfide- or polyurethane-base elastomer caulking material, conforming to ASTM C920.

2.4.4 Escutcheons

Manufacture escutcheons from nonferrous metals and chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Ensure metals and finish conforms to ASME A112.19.2/CSA B45.1.

Use one-piece escutcheons where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. Ensure all escutcheons have provisions consisting of setscrews for maintaining a fixed position against a surface.

2.4.5 Flashing

Ensure sheetlead conforms to ASTM B749.

Ensure sheet copper conforms to ASTM B370 and be not less than 16 ounces per square foot weight.

2.4.6 Flange Gaskets

Provide compressed non-asbestos sheets, conforming to ASTM F104, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.4.7 Grout

Provide shrink-resistant grout as a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C404 and ASTM C476.

Ensure shrink-resistant grout is a combination of pre-measured and packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

| | | |
|---|---|---|
| Tensile strength | | 1,900 psi, minimum |
| Compressive strength | ASTM C109/C109M | 14,000 psi, minimum |
| Shrinkage, linear | | 0.00012 inch per inch, maximum |
| Water absorption | ASTM C67/C67M | 0.1 percent, maximum |
| Bond strength to | | 1,000 psi, minimum steel in shear minimum |

2.4.8 Pipe Thread Compounds

Use polytetrafluoroethylene tape not less than 2 to 3 mils thick in potable and process water and in chemical systems for pipe sizes to and including 1-inch ips. Use polytetrafluoroethylene dispersions and other suitable compounds for all other applications upon approval by the Contracting Officer; however, do not use lead-containing compounds in potable water systems.

2.5 SUPPORTING ELEMENTS

Submit equipment and performance data for the supporting elements consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

Provide all necessary piping systems and equipment supporting elements, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. Ensure supporting elements are suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Ensure supporting elements conform to requirements of ASME B31.3, and MSS SP-58, except as noted.

Ensure attachments welded to pipe are made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Ensure supporting elements exposed to weather are hot-dip galvanized or stainless steel. Select materials of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Electroplate supporting elements in contact with copper tubing with copper.

Type designations specified herein are based on MSS SP-58. Ensure masonry anchor group-, type-, and style-combination designations are in accordance with CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925 , CID A-A-55614, and CID A-A-55615. Provide support elements, except for supplementary steel, that are cataloged, load rated, commercially manufactured products.

2.5.1 Building Structure Attachments

2.5.1.1 Anchor Devices, Concrete and Masonry

Ensure anchor devices conform to CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925, CID A-A-55614, and CID A-A-55615

For cast-in, floor mounted, equipment anchor devices, provide adjustable positions.

Provide built-in masonry anchor devices.

Do not use powder-actuated anchoring devices to support any mechanical systems components.

2.5.1.2 Beam Clamps

Ensure beam clamps are center-loading MSS SP-58 Type 21.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, MSS SP-58 Type 19 may be used for piping sizes 2 inches and less and for piping sizes 2 through 10 inches provided two counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, determine rod diameter in accordance with referenced standards.

2.5.1.3 C-Clamps

Do not use C-clamps.

2.5.1.4 Inserts, Concrete

Use concrete MSS SP-58 Type 18 inserts. When applied to piping in sizes 2 inches ips and larger and where otherwise required by imposed loads, insert and wire a 1-foot length of 1/2-inch reinforcing rod through wing slots. Submit proprietary-type continuous inserts for approval.

2.5.2 Horizontal Pipe Attachments

2.5.2.1 Single Pipes

Support piping in sizes to and including 2-inch ips by MSS SP-58 Type 6 solid malleable iron pipe rings, except that, use split-band-type rings in sizes up to 1-inch ips.

Support piping in sizes through 8-inch ips inclusive by MSS SP-58 Type 1 attachments.

Use MSS SP-58 Type 1 and Type 6 assemblies on vapor-sealed insulated piping and have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

Where thermal movement of a point in a piping system 4 inches and larger would cause a hanger rod to deflect more than 4 degrees from the vertical or where a horizontal point movement exceeds 1/2 inch, use MSS SP-58 Type 41 pipe rolls.

Support piping in sizes larger than 8-inch ips with MSS SP-58 Type 44 through 46 pipe rolls.

Use MSS SP-58 Type 40 shields on all insulated piping. Ensure area of the supporting surface is such that compression deformation of insulated surfaces does not occur. Roll away longitudinal and transverse shield edges from the insulation.

Provide insulated piping without vapor barrier on roll supports with MSS SP-58 Type 39 saddles.

Provide spring supports as indicated.

2.5.2.2 Parallel Pipes

Use trapeze hangers fabricated from structural steel shapes, with U-bolts, in congested areas and where multiple pipe runs occur. Ensure structural steel shapes conform to supplementary steel requirements.

2.5.3 Vertical Pipe Attachments

Ensure vertical pipe attachments are MSS SP-58 Type 8.

Include complete fabrication and attachment details of any spring supports in shop drawings.

2.5.4 Hanger Rods and Fixtures

Use only circular cross section rod hangers to connect building structure attachments to pipe support devices. Use pipe, straps, or bars of equivalent strength for hangers only where approved by the Contracting Officer.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.5.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with AISC 325.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Submit certificates for pipes, valves and specialties showing conformance with test requirements as contained in the reference standards contained in this section. Provide certificates verifying Surface Resistance, Shear and Tensile Strengths, Temperature Ratings, Bending Tests, Flattening Tests and Transverse Guided Weld Bend Tests.

Provide test reports for Hydrostatic Tests, Air Tests, Valve-Operating Tests, Drainage Tests, Pneumatic Tests, Non-Destructive Electric Tests and System Operation Tests, in compliance with referenced standards contained within this section.

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-58, and AWS WHB-2.9.

Submit Installation Drawings for pipes, valves and specialties. Drawings include the manufacturer's design and construction calculations, forces required to obtain rated axial, lateral, or angular movements, installation criteria, anchor and guide requirements for equipment, and equipment room layout and design. Ensure drawings specifically advise on procedures to be followed and provisions required to protect expansion joints during specified hydrostatic testing operations.

Ensure connections between steel piping and copper piping are electrically isolated from each other. Dielectric pipe unions shall be installed to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

Make final connections to equipment with unions flanges installed every 100 feet of straight run. Install unions in the line downstream of screwed- and welded-end valves.

Ream all pipe ends before joint connections are made.

Make screwed joints with specified joint compound with not more than three threads showing after joint is made up.

Apply joint compounds to the male thread only and exercise care to prevent compound from reaching the unthreaded interior of the pipe.

Install screwed unions, welded unions, or bolted flanges wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Securely support piping systems with due allowance for thrust forces, thermal expansion and contraction. Do not subject the system to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Ensure field welded joints conform to the requirements of the AWS WHB-2.9, ASME B31.3, and ASME BPVC SEC IX.

## 3.2 VALVES

Install valves in piping mains and all branches and at equipment where indicated and as specified.

Install valves to permit isolation of branch piping and each equipment item from the balance of the system.

Install riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger. Tap and fit shutoff valve body with a 1/2-inch plugged globe valve.

Install valves unavoidably located in furred or other normally inaccessible places with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

## 3.3 SUPPORTING ELEMENTS INSTALLATION

Install supporting elements in accordance with the referenced codes and standards.

Support piping from building structure. Do not support piping from roof deck or from other pipe.

Run piping parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there is no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Arrange hangars on different adjacent service lines running parallel with each other in line with each other and parallel to the lines of the building.

Install piping support elements at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Base load rating for all pipe-hanger supports on insulated weight of lines filled with water and forces imposed. Deflection per span is not exceed slope gradient of pipe. Ensure supports are in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, reduce the allowable span proportionately:

| PIPE SIZE INCHES | ROD SIZE INCHES | STEEL PIPE FEET | COPPER PIPE FEET |
|---|---|---|---|
| 1 and smaller | 3/8 | 8 | 6 |
| 1-1/4 to 1-1/2 | 3/8 | 10 | 8 |
| 2 | 3/8 | 10 | 8 |
| 2-1/2 to 3-1/2 | 1/2 | 12 | 12 |
| 4 to 5 | 5/8 | 16 | 14 |
| 6 | 3/4 | 16 | 16 |
| 8 to 12 | 7/8 | 20 | 20 |

Install vibration isolation supports where needed..

Support vertical risers independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Ensure risers have guides for lateral stability. For risers subject to expansion, install only one rigid support at a point approximately one-third down from the top. Place clamps under fittings unless otherwise specified. Support carbon-steel pipe at each floor and at not more than 15-foot intervals for pipe 2 inches and smaller and at not more than 20-foot intervals for pipe 2-1/2 inches and larger.

## 3.4 PENETRATIONS

Install effective sound stopping and adequate operating clearance to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceilings where no special acoustic treatment of ceiling is provided. Finish penetrations to be compatible with surface being penetrated.

Accomplish sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 120 degrees F, by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Finish foam with a rasp. Ensure vapor barrier is not less than 1/8-inch thick vinyl coating applied to visible and accessible surfaces. Where high temperatures and fire stopping are a consideration, use only mineral wool with openings covered by 16-gage sheet metal.

## 3.5 SLEEVES

Install sleeves where piping passes through roofs, masonry, concrete walls and floors.

Continuously weld braze sleeves passing through steel decks to the deck.

Ensure sleeves that extend through floors, roofs, load bearing walls, and

fire barriers are continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. Form all other sleeves by molded linear polyethylene liners or similar materials that are removable. Ensure diameter of sleeves is large enough to accommodate pipe, insulation, and jacketing without touching the sleeve and provides a minimum 3/8-inch clearance. Install a sleeve size to accommodate mechanical and thermal motion of pipe precluding transmission of vibration to walls and the generation of noise.

Pack the space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration solid with a mineral fiber conforming to ASTM C553 Type V (flexible blanket), to 1,000 degrees F. Install this packing wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, fill the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration with an elastomer caulk to a depth of 1/2 inch. Ensure all caulked surfaces are oil- and grease-free.

Ensure through-penetration fire stop materials and methods are in accordance with ASTM E814 and UL 1479.

Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

## 3.6 ESCUTCHEONS

Install escutcheons at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, install escutcheons on both sides of the partition. Where suspended ceilings are installed, install plates at the underside only of such ceilings. For insulated pipes, select plates large enough to fit around the insulation. Use chrome-plated escutcheons in all occupied spaces and of size sufficient to effectively conceal openings in building construction. Firmly attach escutcheons with setscrews.

## 3.7 FLASHINGS

Install flashings at penetrations of building boundaries by mechanical systems and related work.

## 3.8 DISINFECTION

Disinfect water piping, including all valves, fittings, and other devices, with a solution of chlorine and water. Ensure the solution contains not less than 50 parts per million (ppm) of available chlorine. Hold solution for a period of not less than 8 hours, after which the solution contains not less than 10 ppm of available chlorine or redisinfect the piping. After successful sterilization, thoroughly flush the piping before placing into service. Flushing is complete when the flush water contains less than 0.5 ppm of available chlorine. Water for disinfected will be furnished by the Government. Approve disposal of contaminated flush water in accordance with written instructions received from the Environmental authority having jurisdiction through the Contracting Officer and all local, State and Federal Regulations.

Flush piping with potable water until visible grease, dirt and other

contaminants are removed (visual inspection).

## 3.9 OPERATION AND MAINTENANCE

Provide Operation and Maintenance Manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Submit test data that is clear and readily legible.

## 3.10 PAINTING OF NEW EQUIPMENT

Factory or shop apply new equipment painting, as specified herein, and provided under each individual section.

### 3.10.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied withstands 125 hours in a salt-spray fog test, except that equipment located outdoors withstand 500 hours in a salt-spray fog test. Conduct salt-spray fog test is in accordance with ASTM B117, and for that test the acceptance criteria is as follows: immediately after completion of the test, the inspected paint shows no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shows no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

Ensure the film thickness of the factory painting system applied on the equipment is not 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, design the factory painting system for the temperature service.

### 3.10.2 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 clean to bare 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. Selected color of finish coat is 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 receives 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 Receives 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 receives two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

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SECTION 23 05 48.19

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SECTION 23 05 48.19

BRACING FOR HVAC
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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.

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 7-16 | (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 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 |

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

| | |
|---|---|
| FEMA P-414 | (January 2004) Installing Seismic Restraints for Duct and Pipe |

METAL FRAMING MANUFACTURERS ASSOCIATION (MFMA)

| | |
|---|---|
| MFMA-4 | (2004) Metal Framing Standards Publication |

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

| | |
|---|---|
| SMACNA 1981 | (2008) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd Edition |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-301-01 | (2019, with Change 1, 2022) Structural Engineering |
| 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 protection measures described in this section and on the drawings to the mechanical equipment and mechanical systems both inside and outside of the building along with exterior utilities and systems listed below. Where there is a conflict between the specifications and the drawings, the specifications will take precedence. Accomplish resistance to lateral forces without consideration of friction resulting from gravity loads.

### 1.2.2 Mechanical Equipment

Mechanical equipment to be protected must include the following items to the extent required on the drawings or in other sections of these specifications:

Equipment/Components weighing 31 lbs or greater

1.2.3 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 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 mechanical equipment designated in paragraph 1.2.2 and systems designated in paragraph 1.2.3 must be developed by the Contractor.

1.2.4 Items Not Covered By This Section

1.2.4.1 Items Requiring No Seismic Restraints

Seismic restraints are not required for the following items:

a. Gas piping less than 1 inch nominal pipe size.

b. Piping in boiler and mechanical equipment rooms less than 1-1/4 inches nominal pipe size.

c. All other piping equal to or less than 3inches nominal pipe size.

d. Rectangular air handling ducts less than 6 square feet in cross sectional area.

e. Round air handling ducts less than 28 inches in diameter.

f. Piping suspended by individual hangers 12 inches or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.

g. Ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the supporting structural member, except as noted below.

In exemptions f. and g. all hangers must meet the length requirements. If the length requirement is exceeded by one hanger in the run, brace the entire run. Seismically protect interior piping and ducts not listed above in accordance with the provisions of this specification.

Non-critical items may require seismic restraints if adjacent to critical equipment or systems that must remain operational after an earthquake and could be compromised by impact with non-critical adjacent components.

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

Coupling and Bracing

Flexible Couplings or Joints

Equipment Restraint

Contractor Designed Bracing; G-AE

SD-03 Product Data

Coupling and Bracing; G-AE

Flexible Couplings Or Joints; G-AE

Equipment Restraint; G-AE

Contractor Designed Bracing; G-AE

Snubbers

Anchor Bolts

Vibration Isolators

SD-05 Design Data

Design Calculations

SD-06 Test Reports

Anchor Bolts; G-RO

## PART 2 PRODUCTS

### 2.1 GENERAL DESIGN REQUIREMENTS

Submit detailed restraint drawings for mechanical equipment, duct systems, piping systems and any other mechanical systems along with calculations, catalog cuts, templates, and erection and installation details, as appropriate, for the items listed below. Indicate thickness, type, grade, class of metal, and dimensions; and show construction details, reinforcement, anchorage, and installation with relation to the building construction. Calculations must be stamped, by a registered structural engineer, and verify the capability of structural members to which bracing is attached for carrying the load from the brace. Include drawing for Mission Critical Equipment indicating the equipment location in the facility sufficient to be used for the installation. 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.

## 2.2 EQUIPMENT RESTRAINT

Equipment must be rigidly or flexibly mounted as indicated in the specifications and/or drawings depending on vibration isolation requirements as follows below.

### 2.2.1 Rigidly (Base and Suspended) Mounted Equipment

HVAC equipment furnished under this contract must be rigidly mounted that are qualified for earthquake loading in accordance with ACI 355.2 and ACI 355.4. Anchor bolts must conform to ASTM F1554. For any rigid equipment which is rigidly anchored, provide flexible joints for piping, ductwork, 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. 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.

Designated Seismic Systems (DSS) assigned to Seismic Design Category (SDC) C, D, E, or F components needed for continued operation after an earthquake must have two nuts provided on each anchor bolt.

### 2.2.2 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 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 manufacturer's will be a member of VISCMA. Design force, Fp, must be doubled for vibration isolators with an air gap greater than 0.25 inches as specified in ASCE 7-16, Chapter 13. Housed springs must not be used for seismic restraint applications because they cannot resist uplift.

## 2.3 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.

## 2.4 FLEXIBLE JOINTS

Flexible joints must have same pressure and temperature ratings as adjoining pipe. Braided hoses must not be used where there is torsional or axial movement unless manufacturer allows it.

2.5 SWAY BRACING MATERIALS

Material used for members listed in this section, must be structural steel conforming with the following:

a. Plates, rods, and rolled shapes, ASTM A36/A36M.

b. Wire rope, ASTM A603 pre-stretched. Ferrule clamps must be qualified by testing for use in seismic applications per VISCMA 412. A minimum of two clamps are required on each end of wire rope.

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

2.6 MULTIDIRECTIONAL SEISMIC SNUBBERS

Install multidirectional seismic snubbers employing elastomeric pads on floor- or slab-mounted equipment as detailed on drawings. These snubbers must provide 1/4 inch free vertical and horizontal movement from the static deflection point. Snubber medium must consist 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.

PART 3 EXECUTION

3.1 COUPLING AND BRACING

a. Submit detail drawings, as specified here and throughout this specification, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals must be complete in detail; must indicate thickness, type, grade, class of metal, and dimensions; and must show construction details, reinforcement, anchorage, and installation with relation to the building construction.

b. Provide coupling installation conforming to the details shown on the drawings. Provisions of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers must be braced at the most frequent interval as determined by applying the requirements of this specification to each piping run on the common support.

c. Size bracing components as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, must not be used where it would interfere with thermal expansion of piping.

d. Adjust isolators and restraints after piping systems has been filled and equipment is at its operating weight, following the manufacturer's written instructions.

e. 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 FLEXIBLE COUPLINGS OR JOINTS

### 3.2.1 Building Piping

Provide flexible couplings or joints in building piping at bottom of all pipe risers for pipe larger than 3-1/2 inches in diameter. Laterally brace flexible couplings or joints without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to satisfy these requirements.

## 3.3 PIPE SLEEVES

Size pipe sleeves in interior non-fire rated walls as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls must conform to the requirements in Section 07 84 00 FIRESTOPPING.

## 3.4 SPREADERS

Provide spreaders between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches apart. Apply spreaders at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Apply spreaders to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

## 3.5 SWAY BRACES FOR PIPING

Provide sway braces to prevent movement of the pipes under seismic loading. Provide braces in both the longitudinal and transverse directions, relative to the axis of the pipe. 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 bracing that does not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications. For seismic analysis of horizontal pipes, the equivalent static force should be considered to act concurrently with the full dead load of the pipe, including contents.

### 3.5.1 Transverse Sway Bracing

Provide transverse sway bracing for steel and copper pipe at intervals not to exceed those shown on the drawings. All runs (length of pipe between end joints) must have a minimum of transverse bracing at each end. Provide transverse sway bracing for pipes of materials other than steel and copper at intervals not to exceed the hanger spacing as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.5.2 Longitudinal Sway Bracing

Provide longitudinal sway bracing at 40 foot intervals unless otherwise indicated. All runs (length of pipe between end joints) must have one longitudinal brace minimum. Construct sway braces in accordance with the drawings. Do not use branch lines, walls, or floors as sway braces.

3.5.3 Vertical Runs

Run is defined as length of pipe between end joints. Do not brace vertical runs of piping no more than 10 foot vertical intervals. Braces for vertical runs must be above the center of gravity of the segment being braced. Flexible couplings should be provided at the bottoms of risers for pipes larger than 3.5 in. (89 mm) in diameter. Flexible couplings and expansion joints should be braced laterally and longitudinally unless such bracing would interfere with the action of the couplings or joints. When pipes enter buildings, flexible couplings should be provided to allow for relative movement between the soil and building. Construct all sway braces in accordance with the drawings. Attach sway braces to the structural system. Do not connect to branch lines, walls, or floors.

3.5.4 Clamps and Hangers

Apply clamps or hangers on uninsulated pipes directly to pipe. Insulated piping must have clamps or hangers applied over insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

Hanger rod stiffener angle or strut bracing must be securely attached by a series of attachment clamps manufactured from a one piece metal stamping and must include all require attachment hardware and locking nuts. Attachment clamps made from aluminum or cast iron must not be used in seismic applications. Do not weld vertical braces to hanger rods.

3.6 SWAY BRACES FOR DUCTS

3.6.1 Braced Ducts

Provide bracing details and spacing for rectangular and round ducts in accordance with SMACNA 1981. However, the design seismic loadings for these items must not be less than loadings obtained using the procedures in UFC 3-301-01. Bracing must not attach to duct joints. Use shortest screws possible when penetrating ductwork to minimize airflow noise inside duct.

3.6.2 Unbraced Ducts

Attach hangers for unbraced ducts to the duct within 2 inches of the top of the duct with a minimum of two #10 sheet metal screws in accordance with FEMA P-414. Use shortest screws possible when penetrating ductwork to minimize airflow noise inside duct. Install unbraced ducts with a 6 inch minimum clearance to vertical ceiling hanger wires.

3.7 EQUIPMENT

3.7.1 General

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.

## 3.8 ANCHOR BOLTS

### 3.8.1 Cast-in-Place Anchor Bolts

Use templates to locate cast-in-place bolts accurately and securely in formwork. Anchor bolts must have 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.

### 3.8.2 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.

#### 3.8.2.1 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% of the specified torque, 100% 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.

#### 3.8.2.2 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.

3.8.2.3 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.

3.9 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.

3.9.1 Torque Wrench Testing

Perform torque wrench testing on not less than 50 percent of the total installed applied torque 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 5 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.

-- End of Section --

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC
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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 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 | (2019) 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 "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class." When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."

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 systems 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. This table is included in the file for Graphics for Unified Facilities Guide Specifications: http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-gra

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system, including records of existing conditions, and systems readiness check. The TAB Specialist must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

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.

1.4 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

Records of Existing Conditions; G-AE

TAB Firm; G-RO

Designation of TAB Team Assistants; G-RO

Designation of TAB Team Engineer; G-RO or TAB Specialist; G-RO

Designation of TAB Team Field Leader; G-RO

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G-AE

SD-03 Product Data

Equipment and Performance Data; G-AE

TAB Related HVAC Submittals; G-AE

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB team engineer.

TAB Procedures; G-AE

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration; G-AE

Systems Readiness Check; G-AE

TAB Execution; G-AE

TAB Verification; G-AE

SD-06 Test Reports

Completed Pre-Final DALT Report; G-RO

Certified Final DALT Report; G-RO

TAB Design Review Report; G-RO

TAB Report for Season 1; G-AE

TAB Report for Season 2; G-AE

SD-07 Certificates

Independent TAB Agency and Personnel Qualifications; G-RO

DALT and TAB Submittal and Work Schedule; G-RO

TAB Pre-Field Engineering Report; G-RO

TAB Firm; G-RO

Design Review Report; G-RO

Pre-field DALT Preliminary Notification; G-RO

Advanced Notice for Season 1 TAB Field Work; G-RO

Prerequisite HVAC Work Check Out List For Season 1; G-RO

Advanced Notice for Season 2 TAB Field Work; G-RO

Prerequisite HVAC Work Check Out List For Season 2; G-RO

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.

1.5.2 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.

1.5.3 Qualifications

1.5.3.1 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, including TAB of environmental systems building systems commissioning.

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.

1.5.3.2 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.

1.5.3.3 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 specified in Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING.

1.5.3.4 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.

1.5.4 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.

1.5.4.1 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 both Season 1 and Season 2 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.

1.5.4.2 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.

1.5.4.3 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 two 8 hour workday duration.

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 and Season 2 TAB field check.

1.5.4.4 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.

1.5.5 Test Reports

1.5.5.1 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.

1.5.5.2 Certified TAB Reports

Submit: TAB Report for Season 1 and TAB Report for Season 2 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 and Season 2 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 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, and heat reclaim devices 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 and branch 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.

## 1.6 PROJECT/SITE CONDITIONS

### 1.6.1 DALT and TAB Services to Obtain Existing Conditions

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct this DALT and TAB work in accordance with the requirements of this section.

## 1.7 SEQUENCING AND SCHEDULING

### 1.7.1 DALT and TAB Submittal and Work Schedule

Submit this schedule,and TAB Schematic Drawings, adapted for this particular contract, to the Contracting Officer (CO) for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Resubmit an updated version for CO approval every 90 calendar days. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-DALT/TAB Meeting: Within 30 calendar days after the date of approval of the TAB agency and personnel, meet with the COTR.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, notify the Contracting Officer in writing within 5 days after completion.

Ductwork Selected for DALT: Within 7 calendar days of Pre-Field DALT Preliminary Notification, the COTR will select which of the project ductwork must be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

DALT Work Field Check: Upon approval of the Pre-final DALT Report, schedule the COTR's DALT field check work with the Contracting Officer.

Submit Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit Season 1 TAB report.

Pre-Field TAB Engineering Report: Within 15 calendar days after approval of the TAB agency Personnel Qualifications, submit the Pre-Field TAB Engineering Report.

Prerequisite HVAC Work Check Out List For Season 1 and Advanced Notice For Season 1 TAB Field Work: At a minimum of 115 calendar days prior to CCD, submit Season 1 prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of Season 1 TAB field work.

Season 1 TAB Field Work: At a minimum of 90 calendar days prior to CCD, and when the ambient temperature is within Season 1 limits, accomplish Season 1 TAB field work.

Submit Season 1 TAB Report: Within 15 calendar days after completion of Season 1 TAB field work, submit Season 1 TAB report.

Season 1 TAB Field Check: 30 calendar days after Season 1 TAB report is approved by the Contracting Officer, conduct Season 1 field check.

Complete Season 1 TAB Work: Prior to CCD, complete all TAB work except Season 2 TAB work.

Prerequisite HVAC Work Check Out List For Season 2 and Advanced Notice For Season 2 TAB Field Work: Within 150 calendar days after date of the commencement of the Season 1 TAB field work, submit the Season 2 prerequisite HVAC work check out list certified as complete and submit advance notice of commencement of Season 2 TAB field work.

Season 2 TAB Field Work: Within 180 calendar days after date of commencement of the Season 1 TAB field work and when the ambient temperature is within Season 2 limits, accomplish Season 2 TAB field

work.

Submit Season 2 TAB Report: Within 15 calendar days after completion of Season 2 TAB field work, submit Season 2 TAB report.

Season 2 TAB Field Check: 30 calendar days after the Season 2 TAB report is approved by the Contracting Officer, conduct Season 2 field check.

Complete Season 2 TAB Work: Within 15 calendar days after the completion of Season 2 TAB field data check, complete all TAB work.

1.7.1.1 TAB Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

1.7.1.2 Pre-Field DALT Preliminary Notification

Notification: On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing within 7 calendar days after completion.

1.7.1.3 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.

1.8 WARRANTY

Furnish workmanship and performance warranty for the DALT and TAB system work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB or DALT workmanship, the corrective repair or replacement of the defective materials and correction of the defective workmanship is the responsibility of the TAB firm. Perform corrective action that becomes necessary because of defective materials and workmanship while system TAB and DALT is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the TAB firm. The Contractor must also provide a 1 year contractor installation warranty.

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 will not exceed 20 percent of the total measured linear footage of duct systems indicated as subject to DALT. 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 only the 20 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.

In spite of specifications of SMACNA 1972 CD to the contrary, DALT ductwork of construction class of 3-inch water gauge static pressure and below if indicated to be DALT'd. Complete DALT work on the COTR selected ductwork within 48 hours after the particular ductwork was selected for DALT. Separately conduct DALT work for large duct systems to enable the DALT work to be completed in 48 hours.

### 3.3.5 Completed Pre-Final DALT Report

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 Certified Final DALT Report

On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TAB Supervisor is to assemble, review, certify and submit the Final DALT Report to the Contracting Officer for approval.

3.3.9 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.

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.

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 Air Handling Units

Air handling unit systems including fans (air handling unit fans, exhaust fans and winter ventilation fans), coils, ducts, plenums, mixing boxes, terminal units, variable air volume boxes, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.4.3.3 Makeup Air Units

Makeup air unit systems including fans, coils, ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.4.3.4 Fan Coils

Fan coil unit systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

3.4.3.5 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.4.4 TAB Water Distribution Systems

3.4.4.1 Heating Hot Water

Heating hot water systems including boilers, pumps, coils, system balancing valves and flow measuring devices.

3.4.5 TAB Work on Performance Tests Without Seasonal Limitations

3.4.5.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the heating systems and cooling systems.

3.4.5.2 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.

3.4.5.3 Coils

Report heating and cooling performance capacity tests for hot water, DX 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 Central station 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".

   Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but 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.

3.4.6 TAB Work on Performance Tests With Seasonal Limitations

3.4.6.1 Performance Tests

Accomplish proportionate balancing TAB work on the air distribution systems and water distribution systems, in other words, accomplish adjusting and balancing of the air flows and water flows, any time during the duration of this contract, subject to the limitations specified elsewhere in this section. However, accomplish, within the following

seasonal limitations, TAB work on HVAC systems which directly transfer thermal energy.

3.4.6.2 Season Of Maximum Load

Visit the contract site for at least two TAB work sessions for TAB field measurements.

3.4.6.3 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.

3.4.6.4 Sound Measurements

Comply with the paragraph SOUND MEASUREMENT WORK, specifically, the requirement that a room must be operating in its noisiest mode at the time of sound measurements in the room. The maximum noise level measurements could depend on seasonally related heat or cooling transfer equipment.

3.4.6.5 Refrigeration Units

For refrigeration compressors/condensers/condensing units,report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.6.6 Coils

Report heating and cooling performance capacity tests for hot water, DX 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 Central station 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."

   Entering and leaving wet and dry bulb temperatures are not determined 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.

3.4.7 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. 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.

3.4.8 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 as soon as possible 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.

3.4.9 TAB Reports

After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph WORKMANSHIP.

3.4.10 Quality Assurance - COTR TAB Field Acceptance Testing

3.4.10.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data (water, air quantities, 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 chillers, boilers, return fans, computer room units, 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 range of plus 5 to minus 5 percent of the TAB Report data, 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.

3.4.10.2 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 range of plus 5 to minus 5 percent of the TAB Report data, 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.

Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

3.4.10.3 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.

3.7 APPENDICES

Appendix D REQUIREMENTS FOR DUCT AIR LEAK TESTING

| Appendix D | | | |
|---|---|---|---|
| REQUIREMENTS FOR DUCT AIR LEAK TESTING | | | |
| | | SYSTEMS | |
| | | Split- System AHU w/VAV | Make-Up Air Units |
| Duct System Static Pressure, in inches W.C. | for Supply | 4 | 4 |
| | for Return | 2 | 2 |
| | for Outside Air | 2 | 2 |
| System Oval/Round Duct and Rectangular Duct SMACNA Seal Class | for Supply | A | A |
| | for Return | A | A |
| | for Outside Air | A | A |
| System Oval/Round Duct SMACNA Leak Class | for Supply | 3 | 3 |
| | for Return | 6 | 6 |
| | for Outside Air | 6 | 6 |
| System Rectangular Duct SMACNA Leak Class | for Supply | 6 | 6 |
| | for Return | 12 | 12 |
| | for Outside Air | 12 | 12 |
| Duct Test Pressure, in inches W.C. | for Supply | 4 | 4 |
| | for Return | 2 | 2 |
| | for Outside Air | 2 | 2 |

| Appendix D | | |
|---|---|---|
| REQUIREMENTS FOR DUCT AIR LEAK TESTING | | |
| | | |
| | | Exhaust Systems |
| Duct System Static Pressure, in millimeters W.C. | for Supply | n/a |
| | for Return | n/a |
| | for Exhaust | 1 |
| | for Outside Air | n/a |
| System Oval/Round Duct and Rectangular Duct SMACNA Seal Class | for Supply | A |
| | for Return | A |
| | for Exhaust | A |
| | for Outside Air | A |
| System Oval/Round Duct SMACNA Leak Class | for Supply | n/a |
| | for Return | n/a |
| | for Exhaust | 12 |
| | for Outside Air | n/a |
| System Rectangular Duct SMACNA Leak Class | for Supply | n/a |
| | for Return | n/a |
| | for Exhaust | 24 |
| | for Outside Air | n/a |

| Appendix D | | |
|---|---|---|
| REQUIREMENTS FOR DUCT AIR LEAK TESTING | | |
| | | |
| | | Exhaust Systems |
| Duct Test Pressure, in inches W.C. | for Supply | n/a |
| | for Return | n/a |
| | for Exhaust | 1 |
| | for Outside Air | n/a |

-- End of Section --

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 07 00

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**02/13, CHG 7: 05/20**

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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 | (2019; Errata 1 2019; Errata 2-6 2020; Addenda BY-CP 2020; Addenda AF-DB 2020; Addenda A-G 2020; Addenda F-Y 2021; Errata 7-8 2021; Interpretation 1-6 2021; Addenda AS-BF 2022) 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 C533 | (2017) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation |
| 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 | (2022) 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 C585 | (2010) Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing |
| 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 C916 | (2020) Standard Specification for Adhesives for Duct Thermal Insulation |
| ASTM C920 | (2018) Standard Specification for Elastomeric Joint Sealants |
| ASTM C921 | (2010; R 2015) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation |
| ASTM C1136 | (2021) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation |
| 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 E84 | (2020) Standard Test Method for Surface Burning Characteristics of Building Materials |
| ASTM E96/E96M | (2022) Standard Test Methods for Gravimetric Determination ofWater Vapor Transmission Rate of Materials |
| ASTM E2231 | (2021) 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 |

FM GLOBAL (FM)

| | |
|---|---|
| FM APP GUIDE | (updated on-line) Approval Guide http://www.approvalguide.com/ |

GREEN SEAL (GS)

| | |
|---|---|
| GS-36 | (2013) Adhesives for Commercial Use |

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

| | |
|---|---|
| ISO 2758 | (2014) Paper - Determination of Bursting Strength |

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 |

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

| | |
|---|---|
| MICA Insulation Stds | (8th Ed) National Commercial & Industrial Insulation Standards |

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 |

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

| | |
|---|---|
| SCAQMD Rule 1168 | (2017) Adhesive and Sealant Applications |

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 Apr 2022) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances |
| UL 723 | (2018) 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-RO

Pipe Insulation Systems and Associated Accessories

Duct Insulation Systems and Associated Accessories

Equipment Insulation Systems and Associated Accessories

Recycled content for insulation materials

SD-03 Product Data

Pipe Insulation Systems; G-AE

Duct Insulation Systems; G-AE

Equipment Insulation Systems; G-AE

SD-07 Certificates

Indoor air quality for adhesives

SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G-RO

Duct Insulation Systems; G-RO

Equipment Insulation Systems; G-RO

## 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 and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable.

#### 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 exceed 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 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.3 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. 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.

2.2.1.4 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/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability

when tested in accordance with ASTM E96/E96M, using the water transmission rate test method; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent Water Vapor Transmission (WVT) rate.

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. 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 ISO 2758. 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 Aboveground Cold Pipeline ( -30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

#### 2.3.2.1 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.

#### 2.3.2.2 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.

#### 2.3.2.3 Mineral Fiber Insulation with Integral Wicking Material (MFIWM)

ASTM C547. Install in accordance with manufacturer's instructions. Do not use in applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

### 2.3.3 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.

2.3.3.1 Mineral Fiber

ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.3.2 Cellular Glass

ASTM C552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.3.3 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 Factory Applied Insulation

Provide factory-applied insulation according to manufacturer's recommendations for insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier.

2.4.1.1 Blanket Insulation

Calculate minimum thickness in accordance with ASTM C553.

2.4.2 Duct Insulation Jackets

2.4.2.1 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.

2.4.2.2 Metal Jackets

2.4.2.2.1 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.

2.4.2.2.2 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.

2.4.2.3 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).

## 2.5 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 in coordination with the submitted MICA Insulation Stds plates booklet. Annotate their installation instructions to indicate which product data and which MICA plate are applicable. 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.

# PART 3 EXECUTION

## 3.1 APPLICATION - GENERAL

Apply insulation to unheated and uncooled piping and equipment. Do not compress flexible elastomeric cellular insulation at joists, studs, columns, ducts, and hangers. The insulation must not pull apart after a one hour period; replace any insulation found to pull apart after one hour.

### 3.1.1 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 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.

### 3.1.2 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.

3.1.3 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.4 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.

3.1.4.1 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.

3.1.4.2 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.

3.1.5 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.

3.1.6 Pipes/Ducts/Equipment That Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items as specified.

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 rom 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 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.

3.2.1.2.6 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 or calcium silicate 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, stainless steel, aluminum or flexible laminate cladding (comprised of elastomeric, plastic or metal foil laminate) 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 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 ofASHRAE 90.1 - IP.

| TABLE 1 | | | | | |
|---|---|---|---|---|---|
| Insulation Material for Piping | | | | | |
| Service | | | | | |
| | Material | Specification | Type | Class | VR/VB Req'd |
| Heating Hot Water Supply & Return, Heated Oil (Max 250 F) | | | | | |
| | Mineral Fiber | ASTM C547 | I | 1 | No |
| | Cellular Glass | ASTM C552 | II | 2 | No |
| | Flexible Elastomeric Cellular | ASTM C534/C534M | I | 2 | No |
| Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping | | | | | |
| | Mineral Fiber | ASTM C547 | I | 1 | No |
| | 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 |
| | Cellular Glass | ASTM C552 | II | 1 | Yes |
| 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 | | | | | |
| | Cellular Glass | ASTM C552 | II | 2 | No |
| | Flexible Elastomeric Cellular | ASTM C534/C534M | I | | No |

TABLE 2

Piping Insulation Thickness (inch)

| Service | Material | Tube And Pipe Size (inch) | | | | |
|---|---|---|---|---|---|---|
| | | <1 | 1-<1.5 | 1.5-<4 | 4-<8 | > or = >8 |
| Heating Hot Water Supply & Return, Heated Oil (Max 250 F) | | | | | | |
| | Mineral Fiber | 1.5 | 1.5 | 2 | 2 | 2 |
| | Cellular Glass | 2 | 2.5 | 3 | 3 | 3 |
| | Flexible Elastomeric Cellular | 1 | 1 | 1 | N/A | N/A |
| 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 |
| | Cellular Glass | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| 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 | | | | | | |
| | Cellular Glass | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| | Flexible Elastomeric Cellular | 1 | 1 | 1 | N/A | N/A |

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 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. 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, sliver, white, black and embossed for use with Mineral Fiber, Cellular Glass, and Phenolic Foam Insulated Pipe. Insulation inside the building, to be protected with an aluminum jacket or 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. The aluminum jacket or 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 be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets or 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 be provided for pipe insulation to the 6 ft level.

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. Hot water heating.

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".

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions. Duct insulation minimum thickness and insulation level must be as listed in Table 3 and must meet or exceed the requirements of ASHRAE 90.1 - IP.

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

### 3.3.1 Duct Insulation Minimum Thickness

Duct insulation minimum thickness in accordance with Table 4.

| Table 4 - Minimum Duct Insulation (inches) | |
|---|---|
| Cold Air Ducts | 2.0 |
| Relief Ducts | 1.5 |
| Fresh Air Intake Ducts | 1.5 |

### 3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold 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. Coil headers and return bends.

f. Coil casings.

g. Fresh air intake ducts.

h. 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 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 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.4 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.

## 3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

Install equipment insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

### 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. Air handling equipment parts that are not factory insulated.

#### 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 |

#### 3.4.2.2 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. Exposed insulation corners shall be protected with corner angles.

e. 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.

3.4.2.3 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. Hot water generators.

b. Water heaters.

c. Pumps handling media above 130 degrees F.

d. Air separation tanks.

e. Unjacketed boilers or parts of boilers.

f. Boiler flue gas connection from boiler to stack (if inside).

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

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) |
| 15 psig or 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 |
| 600 degrees F: Thickness necessary to limit the external temperature of the insulation to 120 F. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection. | | |

3.4.3.2 Insulation of Boiler Stack Exhaust Pipe

Inside mechanical Room, bevel insulation neatly around openings and provide sheet metal insulation stop strips around such openings. Apply a skim coat of hydraulic setting cement directly to insulation. Apply a flooding coat of adhesive over hydraulic setting cement, and while still wet, press a layer of glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat glass cloth with adhesive. When dry, apply a finish coat of adhesive at can-consistency so that when dry no glass weave shall be observed. Provide metal jackets for exhaust pipes that are located above finished floor and spaces outside mechanical room. Apply metal jackets directly over insulation and secure with 3/4 inch wide metal bands spaced on 18 inch centers. Do not insulate name plates. Insulation type and thickness shall be in accordance with the following Table 7.

TABLE 7

Insulation and Thickness for
Boiler Stack and Diesel Engine Exhaust Pipe

| Service & Surface Temperature Range (Degrees F) | | | | | | |
|---|---|---|---|---|---|---|
| | Material | Outside Diameter (Inches) | | | | |
| | | 0.25 - 1.25 | 1 - 1.67 | 3.5-5 | 6 - 10 | > or = 11 - 36 |
| Boiler Stack (Up to 400 degrees F) | | | | | | |
| | Mineral Fiber<br>ASTM C585 Class B-3,<br>ASTM C547 Class 1, or<br>ASTM C612 Class 1 | N/A | N/A | 3 | 3.5 | 4 |
| | Calcium Silicate<br>ASTM C533, Type 1 | N/A | N/A | 3 | 3.5 | 4 |
| | Cellular Glass<br>ASTM C552, Type II | 1.5 | 1.5 | 1.5 | 2 | 2.5 |

3.4.3.3 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.

3.4.3.4 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 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.

-- End of Section --

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QC Checklist for BACnet Systems

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QC CHECKLIST FOR BACNET SYSTEMS

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SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC
**02/19, CHG 3: 05/21**

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) 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 and 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 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, unless otherwise pre-approved by the Contracting Officer.

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.

1.1.2 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.

1.1.3 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.

1.1.4 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 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL 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.

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 | (2021) 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 | (2020) Enclosures for Electrical Equipment (1000 Volts Maximum) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |
| NFPA 90A | (2021) Standard for the Installation of Air Conditioning and Ventilating Systems |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 5085-3 | (2006; Reprint Jan 2022) UL Standard for Safety 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.

### 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) |

| The following is a list of some BIBBs used by this or referenced Sections: | |
|---|---|
| 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) |
| 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 ASHRAE 135 networks (in a BACnet system) 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; these dates are specified in the contract documents.

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) |
|---|---|---|---|
| 1 | S | Existing Conditions Report | |
| 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 |

| TABLE II. PROJECT SEQUENCING | | | |
|---|---|---|---|
| ITEM # | TYPE | DESCRIPTION | SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL) |
| 6 | E | Start-Up and Start-Up Testing | ACO #5 |
| 7 | S | Post-Construction QC Checklist | ACO #6 |
| 8 | S | Programming Software<br>Configuration Software | ACO #6 |
| 10 | S | Start-Up Testing Report | ACO #6 |
| 11 | S | PVT Procedures | before schedule start of #12 and AAO #10 |
| 12 | S,E | Execute PVT<br>PVT Testing Activities | AAO #9 and #11<br>As indicated in PART 3 of this Section |
| 13 | S | PVT Report | ACO #12<br>As indicated in PART 3 of this Section |
| 14 | S | Controller Application Programs<br>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 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-AE

Final As-Built Drawings; G-AE

SD-03 Product Data

Programming Software; G-AE

Controller Application Programs; G-AE

Configuration Software; G-AE

Controller Configuration Settings; G-AE

Manufacturer's Product Data; G-AE

SD-06 Test Reports

Existing Conditions Report

Pre-Construction Quality Control (QC) Checklist; G-RO

Post-Construction Quality Control (QC) Checklist; G-RO

Start-Up Testing Report; G-RO

PVT Procedures; G-RO

PVT Report; G-RO

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G-RO

Training Documentation; G-RO

SD-11 Closeout Submittals

Enclosure Keys; G-RO

Password Summary Report; G-RO

Closeout Quality Control (QC) Checklist; G-RO

## 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 4 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 4 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 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 Checklist for Niagara Framework Based 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.

1.9.1 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.

1.9.2 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.

1.9.3 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 3 requirements.

### 2.5.2 Mechanical and Electrical Rooms

For enclosures located in mechanical or electrical rooms, provide enclosures meeting NEMA 250 Type 2 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 EXISTING CONDITIONS

### 3.1.1 Existing Conditions Survey

Perform a field survey, including testing and inspection of the equipment to be controlled and submit an Existing Conditions Report documenting the current status and its impact on the Contractor's ability to meet this specification. For those items considered nonfunctional, document the

deficiency in the report including explanation of the deficiencies and estimated costs to correct the deficiencies. As part of the report, define the scheduled need date for connection to existing equipment. Make written requests and obtain Government approval prior to disconnecting any controls and obtaining equipment downtime.

Submit four copies of the Existing Conditions Report.

3.1.2 Existing Equipment Downtime

Make written requests and obtain Government approval prior to disconnecting any controls and obtaining equipment downtime.

3.1.3 Existing Control System Devices

Inspect, calibrate, and adjust as necessary to place in proper working order all existing devices which are to be reused.

3.2 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 or Niagara BACnet systems, and this Section.

3.2.1 Dielectric Isolation

Provide dielectric isolation where dissimilar metals are used for connection and support. Install control system in a matter 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.

3.2.2 Penetrations in Building Exterior

Make all penetrations through and mounting holes in the building exterior watertight.

3.2.3 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.

3.2.4 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

3.2.5 Surge Protection

3.2.5.1 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.

3.2.5.2 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.

3.2.6 Basic Cybersecurity Requirements

3.2.6.1 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 RO. Provide a Password Summary Report documenting the password for each device and describing the procedure to change the password for each device.

Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.2.6.2 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.

3.2.6.3 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.

3.3 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 or A3 17 by 11 inches sheets, and electronic drawings in PDF and in AutoCAD Autodesk Revit 2013 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: Six hard copies and four copies on CD-ROM.

b. 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: Six hard copies and four copies on CD-ROM.

3.3.1 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.

3.3.2 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.

3.3.3 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.

3.3.4 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.

3.3.5 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.

3.3.6 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.

3.3.7 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.

3.3.8 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.

3.3.9 DDC Hardware Schedule

Provide a single DDC Hardware Schedule for the entire project and including following information for each device.

3.3.9.1 DDC Hardware Identifier

The Unique DDC Hardware Identifier for the device.

3.3.9.2 HVAC System

The system "name" used to identify a specific system (the name used on the system schematic drawing for that system).

3.3.9.3 BACnet Device Information

3.3.9.3.1 Device Object Identifier

The Device Object Identifier: The Object_Identifier of the Device Object

3.3.9.3.2 Network Number

The Network Number for the device.

3.3.9.3.3 MAC Address

The MAC Address for the device

3.3.9.3.4 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.

3.3.9.3.5 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.

3.3.9.3.6 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.

3.3.9.3.7 Scheduling Information

Indicate whether the device is used for scheduling.

3.3.9.3.8 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.

3.3.10 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:

3.3.10.1 Point Name

The abbreviated name for the point using the indicated naming convention.

3.3.10.2 Description

A brief functional description of the point such as "Supply Air Temperature".

3.3.10.3 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.

3.3.10.4 Settings

The value and units of any setpoints, configured setpoints, configuration parameters, and settings related to each point.

3.3.10.5 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.

3.3.10.6 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.

3.3.10.7 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.

3.3.10.8 Network Data Exchange Information (Gets Data From, Sends Data To)

Provide the DDC Hardware Identifier of other DDC Hardware the point is shared with.

3.3.10.9 Override Information (Object Type and Instance Number)

For each point requiring an Override and not residing in a Niagara Framework Supervisory Gateway, 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.

3.3.10.10 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.

3.3.10.11 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.)

3.3.10.12 Configuration Information

Indicate the means of configuration associated with each point. For points in a Niagara Framework Supervisory Gateway, indicate the point within the Niagara Framework Supervisory Gateway used to configure the value. For other points:

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.

3.3.11 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.

3.3.12 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.

3.3.13 Sequences of Operation

Provide HVAC control system sequence of operation in the same format as the Contract Drawings. Within these drawings, refer to devices by their unique identifiers. Submit sequences of operation for each HVAC system.

3.3.14 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.

3.4 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.

3.5 START-UP

3.5.1 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.

3.5.1.1 Systems Check

An item-by-item check must be performed for each HVAC system

3.5.1.1.1 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.

3.5.1.1.2 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.

3.5.1.1.3 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.

3.5.1.2 Weather Dependent Test

Perform weather dependent test procedures in the appropriate climatic season.

3.5.2 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).

## 3.6 PERFORMANCE VERIFICATION TEST (PVT)

### 3.6.1 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.

#### 3.6.1.1 Sensor Accuracy Checks

Include a one-point accuracy check of each sensor in the PVT procedures.

#### 3.6.1.2 Temporary Trending Hardware

Unless trending capability exists within the building control system or the building control system is connected to a UMCS or other system which can perform trending, temporarily install hardware on the building control network to perform trending during the endurance test as indicated. Remove the temporary hardware at the completion of all commissioning activities.

#### 3.6.1.3 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.

#### 3.6.1.4 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

### 3.6.2 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-Builts 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.

3.6.3 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.

3.7 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.

3.8 TRAINING

Conduct a training course for 8 operating staff members designated by the Government in the maintenance and operation of the system, including specified hardware and software. Conduct 32 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 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**

**QC CHECKLIST FOR BACNET SYSTEMS**

This checklist is not all-inclusive of the requirements of this specification and should not be interpreted as such.

Instructions: Initial each item in the space provided (|____|) verifying that the requirement has been met.

This checklist is for (circle one:)

Pre-Construction QC Checklist Submittal

Post-Construction QC Checklist Submittal

Close-out QC Checklist Submittal

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. | |
| 9 | O&M Instructions have been completed and submitted. | \|____\| |

| | **QC CHECKLIST FOR BACNET SYSTEMS** | |
|---|---|---|
| 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 | \|____\| |
| | _____ _____ | |
| | (QC Representative Signature) (Date) | |

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SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
**11/15, CHG 2: 05/21**

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 23 30 00 HVAC AIR DISTRIBUTION

Section 23 05 15 COMMON PIPING FOR HVAC

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 | (2021) 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 | (2021) 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 ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2020) Enclosures for Electrical Equipment (1000 Volts Maximum) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |
| NFPA 90A | (2021) Standard for the Installation of Air Conditioning and Ventilating Systems |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 5085-3 | (2006; Reprint Jan 2022) UL Standard for Safety 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.

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 IV 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.

2.4.2 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.

2.4.2.2 Three-Way Modulating Valves

Provide the valve coefficient (Cv) indicated. Provide linear flow characteristic with constant total flow throughout full plug travel.

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.

d. Provide valves compatible with a solution of 50 percent ethylene or propylene glycol.

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 Pressure Independent Control Valves (PICV)

Provide pressure independent control valves which include a regulator valve which maintains the differential pressure across a flow control valve. Pressure independent control valves must accurately control the flow from 0-100 percent full rated flow regardless of changes in the piping pressure and not vary the flow more than plus or minus 5 percent at any given flow control valve position when the PICV differential pressure lies between the manufacturer's stated minimum and maximum. The rated minimum differential pressure for steady flow must not exceed 5 psid across the PICV. Provide either globe or ball type valves meeting the indicated requirements for globe and ball valves. Provide valves with a flow tag listing full rated flow and minimum required pressure drop. Provide valves with factory installed Pressure/Temperature ports ("Pete's Plugs") to measure the pressure drop to determine the valve flow rate.

2.4.8 Duct-Coil and Terminal-Unit-Coil Valves

For duct or terminal-unit coils provide control valves with either flare-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 steel, or other materials where indicated and with assembly frames constructed of 0.07 inch minimum thickness stainless 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 3 dampers. Provide dampers rated at not less than 1500 ft/min air velocity.

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 mAdc, 0-10 Vdc 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

For pipes with larger than 3 inch diameter, provide minimum 3 inch immersion. For pipes with less than 3 inch diameter, provide immersion at least half the diameter of the pipe. 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 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.

2.6.6 Differential Pressure Instrumentation

2.6.6.1 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

2.6.6.2 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.

2.6.7 Flow Sensors

2.6.7.1 Airflow Measurement Array (AFMA)

2.6.7.1.1 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.

2.6.7.1.2 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.

2.6.7.1.3 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.

2.6.7.1.4 Pitot Tube AFMA

Each Pitot Tube AFMA must contain an array of velocity sensing elements. The velocity sensing elements must be of the multiple pitot tube type with averaging manifolds. The sensing elements must be distributed across the duct cross section in the quantity and pattern specified or recommended by the published installation instructions of the AFMA manufacturer.

a. Pitot Tube AFMAs for use in airflows over 600 fpm must have an accuracy of plus or minus 5 percent over a range of 500 to 2500 fpm.

b. Pitot Tube AFMAs for use in airflows under 600 fpm must have an accuracy of plus or minus 5 percent over a range of 125 to 2500 fpm.

2.6.7.1.5 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.

2.6.7.1.6 Fan Inlet Measurement Devices

Fan inlet measurement devices cannot be used unless indicated on the drawings or schedules.

2.6.7.2 Orifice Plate

Orifice plate must be made of an austenitic stainless steel sheet of 0.125 inch nominal thickness with an accuracy of plus or minus 1 percent of full flow. The orifice plate must be flat within 0.002 inches. The orifice surface roughness must not exceed 20 micro-inches. The thickness of the cylindrical face of the orifice must not exceed 2 percent of the pipe inside diameter or 12.5 percent of the orifice diameter, whichever is smaller. The upstream edge of the orifice must be square and sharp. Where orifice plates are used, concentric orifice plates must be used in all applications except steam flow measurement in horizontal pipelines.

2.6.7.3 Flow Nozzle

Flow nozzle must be made of austenitic stainless steel with an accuracy of plus or minus 1 percent of full flow. The inlet nozzle form must be elliptical and the nozzle throat must be the quadrant of an ellipse. The thickness of the nozzle wall and flange must be such that distortion of the nozzle throat from strains caused by the pipeline temperature and pressure, flange bolting, or other methods of installing the nozzle in the pipeline must not cause the accuracy to degrade beyond the specified limit. The outside diameter of the nozzle flange or the design of the flange facing must be such that the nozzle throat must be centered accurately in the pipe.

2.6.7.4 Venturi Tube

Venturi tube must be made of cast iron or cast steel and must have an

accuracy of plus or minus 1 percent of full flow. The throat section must be lined with austenitic stainless steel. Thermal expansion characteristics of the lining must be the same as that of the throat casting material. The surface of the throat lining must be machined to a plus or minus 50 micro inch finish, including the short curvature leading from the converging entrance section into the throat.

2.6.7.5 Annular Pitot Tube

Annular pitot tube must be made of austenitic stainless steel with an accuracy of plus or minus 2 percent of full flow and a repeatability of plus or minus 0.5 percent of measured value. The unit must have at least one static port and no less than four total head pressure ports with an averaging manifold.

2.6.7.6 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.

2.6.7.7 Vortex Shedding Flowmeter

Vortex Shedding Flowmeter accuracy must be within plus or minus 0.8 percent of the actual reading over the range of the meter. Steam meters must contain density compensation by direct measurement of temperature. Mass flow inferred from specified steam pressure are not acceptable. The flow meter body must be made of austenitic stainless steel and include a weather tight NEMA 4X electronics enclosure. The vortex shedding flowmeter body must not require removal from the piping in order to replace the shedding sensor.

2.6.7.8 Ultrasonic Flow Meter

Provide Ultrasonic Flow Meters complete with matched transducers, self aligning installation hardware and transducer cables. Ultrasonic transducers must be optimized for the specific pipe and process conditions for the application. The flow meter accuracy must plus or minus 1 percent of rate from 0 to 40 ft/sec. The flowmeter must include either dry contact pulse outputs, 4-20mA, 0-10Vdc or 0-5Vdc output.

2.6.7.9 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.

2.6.7.10 Positive Displacement Flow Meter

The flow meter must be a direct reading, gerotor, nutating disc or vane type displacement device rated for liquid service as indicated. A counter must be mounted on top of the meter, and must consist of a non-resettable mechanical totalizer for local reading, and a pulse transmitter for remote reading. The totalizer must have a six digit register to indicate the volume passed through the meter in gallons, and a sweep-hand dial to indicate down to 0.25 gallons. The pulse transmitter must have a hermetically sealed reed switch which is activated by magnets fixed on gears of the counter. The meter must have a bronze body with threaded or flanged connections as required for the application. Output accuracy must be plus or minus 2 percent of the flow range. The maximum pressure drop at full flow must be 5 psig.

2.6.7.11 Flow Meters, Paddle Type

Sensor must be non-magnetic, with forward curved impeller blades designed for water containing debris. Sensor accuracy must be plus or minus 1 percent of rate of flow, minimum operating flow velocity must be 1 foot per second. Sensor repeatability and linearity must be plus or minus 1 percent. Materials which will be wetted must be made from non-corrosive materials and must not contaminate water. The sensor must be rated for installation in pipes of 3 to 40 inch diameters. The transmitter housing must be a NEMA 250 Type 4 enclosure.

2.6.7.12 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.

2.6.7.13 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.

2.6.8 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.

2.6.8.1 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.

2.6.8.2 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.

2.6.8.3 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.

2.6.9 pH Sensor

The sensor must be suitable for applications and chemicals encountered in water treatment systems of boilers, chillers and condenser water systems. Construction, wiring, fittings and accessories must be corrosion and chemical resistant with fittings for tank or suspension installation. Housing must be polyvinylidene fluoride with O-rings made of chemical resistant materials which do not corrode or deteriorate with extended exposure to chemicals. The sensor must be encapsulated. Periodic replacement must not be required for continued sensor operation. Sensors must use a ceramic junction and pH sensitive glass membrane capable of withstanding a pressure of 100 psig at 150 degrees F. The reference cell must be double junction configuration. Sensor range must be 0 to 12 pH, stability 0.05, sensitivity 0.02, and repeatability of plus or minus 0.05 pH value, response of 90 percent of full scale in one second and a linearity of 99 percent of theoretical electrode output measured at 76 degrees F.

2.6.10 Oxygen Analyzer

Oxygen analyzer must consist of a zirconium oxide sensor for continuous sampling and an air-powered aspirator to draw flue gas samples. The analyzer must be equipped with filters to remove flue air particles. Sensor probe temperature rating must be 815 degrees F. The sensor assembly must be equipped for flue flange mounting.

2.6.11 Carbon Monoxide Analyzer

Carbon monoxide analyzer must consist of an infrared light source in a weather proof steel enclosure for duct or stack mounting. An optical detector/analyzer in a similar enclosure, suitable for duct or stack mounting must be provided. Both assemblies must include internal blower

systems to keep optical windows free of dust and ash at all times. The third component of the analyzer must be the electronics cabinet. Automatic flue gas temperature compensation and manual/automatic zeroing devices must be provided. Unit must read parts per million (ppm) of carbon monoxide in the range of 0 to 300 ppm and the response time must be less than 3 seconds to 90 percent value. Unit measurement range must not exceed specified range by more that 50 percent. Repeatability must be plus or minus 1 percent of full scale with an accuracy of plus or minus 1 percent of full scale.

2.6.12 Vibration Switch

Vibration switch must be solid state, enclosed in a NEMA 250 Type 4 or Type 4X housing with sealed wire entry. Unit must have two independent sets of Form C switch contacts with one set to shutdown equipment upon excessive vibration and a second set for monitoring alarm level vibration. The vibration sensing range must be a true rms reading, suitable for the application. The unit must include either displacement response for low speed or velocity response for high speed application. The frequency range must be at least 3 Hz to 500 Hz. Contact time delay must be 3 seconds. The unit must have independent start-up and running delay on each switch contact. Alarm limits must be adjustable and setpoint accuracy must be plus or minus 10 percent of setting with repeatability of plus or minus 2 percent.

2.6.13 Conductivity Sensor

Sensor must include local indicating meter and must be suitable for measurement of conductivity of water in boilers, chilled water systems, condenser water systems, distillation systems, or potable water systems as indicated. Sensor must sense from 0 to 10 microSeimens per centimeter (µS/cm) for distillation systems, 0 to 100 µS/cm for boiler, chilled water, and potable water systems and 0 to 1000 µS/cm for condenser water systems. Contractor must field verify the ranges for particular applications and adjust the range as required. The output must be temperature compensated over a range of 32 to 212 degrees F. The accuracy must be plus or minus 2 percent of the full scale reading. Sensor must have automatic zeroing and must require no periodic maintenance or recalibration.

2.6.14 NOx Monitor

Monitor must continuously monitor and give local indication of boiler stack gas for NOx content. It must be a complete system designed to verify compliance with the Clean Air Act standards for NOx normalized to a 3 percent oxygen basis and must have a range of from 0 to 100 ppm. Sensor must be accurate to plus or minus 5 ppm. Sensor must output NOx and oxygen levels and binary output that changes state when the NOx level is above a locally adjustable NOx setpoint. Sensor must have normal, trouble and alarm lights. Sensor must have heat traced lines if the stack pickup is remote from the sensor. Sensor must be complete with automatic zero and span calibration using a timed calibration gas system, and must not require periodic maintenance or recalibration.

2.6.15 Temperature Switch

2.6.15.1 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.

2.6.15.2 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.

2.6.16 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. 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.

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 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.

2.8.1 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.

## 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 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, 60 inches above the floor unless otherwise indicated. Install adjustable devices to be ADA compliant unless otherwise indicated.

### 3.1.4 Switches

#### 3.1.4.1 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.

#### 3.1.4.2 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.

### 3.1.5 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.

#### 3.1.5.1 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 5 feet above the finished floor. Non user-adjustable sensors can be mounted as indicated in paragraph ROOM INSTRUMENT MOUNTING.

#### 3.1.5.2 Duct Temperature Sensors

##### 3.1.5.2.1 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.

##### 3.1.5.2.2 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.

3.1.5.3 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.

3.1.5.4 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.

3.1.6 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.

3.1.7 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.

3.1.8 Relative Humidity Sensors

Install relative humidity sensors in supply air ducts at least 10 feet downstream of humidity injection elements.

### 3.1.9 Meters

#### 3.1.9.1 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.

### 3.1.10 Dampers

#### 3.1.10.1 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 nay 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.

#### 3.1.10.2 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 it's 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.

### 3.1.11 Valves

Install the valves in accordance with the manufacturer's instructions.

#### 3.1.11.1 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.

### 3.1.12 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.

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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 10 10 UTILITY MONITORING AND CONTROL (UMCS) FRONT END AND INTEGRATION, 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 Compatibility

Provide systems compatible Honeywell Comfort Point Open Studio BACnet in order to integrate into Ellsworth's Honeywell EBI R500 or newer front end with full read and write capabilities on all of the data points to be monitored. All new DDC control hardware/software must have permission to operate under the current Ellsworth ATO (Authorization to Operate).

1.1.2 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.

1.1.3 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; Reprint Oct 2021) UL Standard for Safety 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 devices used as BACnet routers 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 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-5e 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 or Niagara Framework Points 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. 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 mAdc or 0-10 Vdc. 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.)

2.3.3 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 Niagara Framework points or 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

Non-Niagara Framework 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. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Notification Class 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.

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.

b. Coordinate device IP addresses with installation.

3.1.2.2 ASHRAE 135 Object Name Property and Object Description Property

Configure the Object_Names and Object_Descriptions properties of all ASHRAE 135 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 the RO 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 eternal 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 and override values of ASHRAE 135 Object Properties as indicated on the Points Schedule. Install LDPs displaying points for anything other than a terminal unit in the same room as the equipment. Install LDPs displaying points for only terminal units in a mechanical room central to the group of terminal units it serves. For LDPs using WriteProperty to commandable objects to implement an override, write values with priority 9.

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. Differential Air pressures in inches of water column (IWC)

e. Water, steam, and natural gas pressures in PSI

f. Enthalpy in BTU/lb

g. Heating and cooling energy in MBTU (1MBTU = 1,000,000 BTU))

h. Cooling load in tons (1 ton = 12,000 BTU/hour)

i. Heating load in MBTU/hour (1MBTU = 1,000,000 BTU)

j. Electrical Power: kilowatts (kW)

k. 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.

f. Use a combination of Niagara Framework Alarm Extensions and Alarm Services, 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 (including Niagara Frameworks Supervisory Gateways when communicating with non-Niagara Framework 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 in non-Niagara Framework Hardware 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 singe 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.

g. Future Trending support. Provide support for future trending:

(1) Provide one or more devices on the Building Control Network Backbone IP network which support both the T-VMT-E-B and DM-OCD-B

BIBBs for Trend Log Objects. Provide sufficient devices to support the creation of at least one additional Trend Log Object for every terminal unit plus 4 additional Trend Log Objects for every non-terminal unit.

(2) Provide one additional Trend Log Object for every terminal unit plus 4 additional Trend Log Objects for every non-terminal unit in one or more devices on the Building Control Network Backbone IP network that support the T-VMT-E-B BIBB for later use by the site.

(3) A combination of these two methods is permitted provided the total required number of Trend Log Objects is met.

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 in non-Niagara Framework Supervisory Gateway DDC Hardware. 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. (Note: A Niagara Framework Supervisory Gateway is BACnet control hardware.)

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 11 20

FACILITY GAS PIPING
**05/20**

PART 1 GENERAL

1.1 SUMMARY

This specification section applies to gas piping installed within buildings incidental underground piping under building, above ground steel piping and corrugated stainless steel tubing (CSST) both outside (up to 5 feet beyond exterior walls) and within buildings in compliance with NFPA 54 /AGA Z223.1, "National Fuel Gas Code" NFPA 58, "Fuel Gas 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 GAS ASSOCIATION (AGA)

| | |
|---|---|
| AGA ANSI B109.1 | (2000) Diaphragm Type Gas Displacement Meters (Under 500 cubic ft./hour Capacity) |
| AGA ANSI B109.2 | (2000) Diaphragm Type Gas Displacement Meters (500 cubic ft./hour Capacity and Over) |
| AGA ANSI B109.4 | (2016) Self-Operated Diaphragm-Type Natural Gas Service Regulators for Nominal Pipe Size 1¼ inches (32 mm) and Smaller with Outlet Pressures of 2 psig (13.8 kPa) and Less |
| AGA Z223.1 | (2012) National Fuel Gas Code |

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

| | |
|---|---|
| ANSI Z21.15/CSA 9.1 | (2021) Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves |
| ANSI Z21.18/CSA 6.3 | (2007; R 2017) Gas Appliance Pressure Regulators |
| ANSI Z21.21/CSA 6.5 | (2019) Automatic Valves for Gas Appliances |
| ANSI Z21.24/CSA 6.10 | (2022) 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 Z21.80/CSA 6.22 | (2019) Line Pressure Regulators |
| 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 CIVIL ENGINEERS (ASCE)

| | |
|---|---|
| ASCE 25-16 | (2016) Earthquake-Activated Automatic Gas Shutoff Devices |

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 | (2021) 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 | (2021) 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 | (2022) Nuts for General Applications: Machine Screw Nuts, and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series) |
| ASME B31.8 | (2018; Supplement 2018) Gas Transmission and Distribution Piping Systems |
| ASME B31.9 | (2020) Building Services Piping |
| ASME B36.10M | (2022) 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 |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.8/A5.8M | (2019) Specification for Filler Metals for Brazing and Braze Welding |
| AWS WHB-2.9 | (2004) Welding Handbook; Volume 2, Welding Processes, Part 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 | (2021) 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 | (2022) 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 |
| ASTM F2015 | (2000; R 2013) Standard Specification for Lap Joint Flange Pipe End Applications |
| CSA GROUP (CSA) | |
| ANSI LC 1/CSA 6.26 | (2019) Fuel Gas Piping Systems Using Corrugated Stainless Steel Tubing (CSST) |
| CGA 3.11-M88 | (2015) Lever Operated Pressure Lubricated Plug Type Gas Shut-Off Valves |
| FM GLOBAL (FM) | |
| FM APP GUIDE | (updated on-line) Approval Guide http://www.approvalguide.com/ |
| 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 58 | (2020; TIA 20-1; TIA 20-2; TIA 20-3) Liquefied Petroleum Gas Code |
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |
| U.S. DEPARTMENT OF DEFENSE (DOD) | |
| MIL-STD-101 | (2014; Rev C) Color Code for Pipelines and for Compressed Gas Cylinders |
| UFC 3-301-01 | (2019, with Change 1, 2022) Structural Engineering |
| 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.

### 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-AE

SD-03 Product Data

Steel Pipe, Joints, and Fittings; G-AE

Gas Equipment Connectors; G-AE

Gas Piping System; G-AE

Pressure Regulators; G-AE

Valves; G-AE

Warning and Identification Tape; G-AE

SD-06 Test Reports

Testing; G-RO

Pressure Tests; G-RO

Test with Gas; G-RO

SD-07 Certificates

Welders Procedures and Qualifications; G-RO

Assigned Number, Letter, or Symbol; G-RO

SD-08 Manufacturer's Instructions

Pipe Coating Materials; G-RO

SD-10 Operation and Maintenance Data

Gas Facility System and Equipment Operation; G-RO

Gas Facility System Maintenance; G-RO

Gas Facility Equipment Maintenance; G-RO

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. Weld all structural members in accordance with Section 05 05 23.16 STRUCTURAL WELDING, and in conformance with AWS A5.8/A5.8M, and AWS WHB-2.9.

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.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 CSST Tubing

Handle, transport and store CSST tubing on the wooden spool or shipping container provided by the manufacturer. Insure tubing ends are capped during transportation and storage to minimize dirt and moisture entry. Discard any tubing segment and fitting that has been damaged.

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 54NFPA 58 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 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 buttwelding 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

Provide corrugated stainless steel tubing conforming to ANSI LC 1/CSA 6.26 (austenitic stainless steel of series 300) with tubing joints made with special mechanical fittings as supplied by the tubing manufacturer.

2.2.3.1 Tubing

Austenitic stainless alloy of series 300 with polyethylene jacket/coating in accordance with ANSI LC 1/CSA 6.26 for sizes 3/8-inch through 2-inch

2.2.3.2 Mechanical Fittings

Copper alloy with one end matched to the corrugated tubing and one end with NPT threads in accordance with ASME B1.20.1

2.2.3.3 Striker Plates

Hardened steel designed to protect tubing from mechanical damage in accordance with ANSI LC 1/CSA 6.26

2.2.3.4 Manifolds

Malleable iron, steel or copper alloy with threaded connections/ports in accordance with ASME B1.20.1

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 Gas Transition Fittings

a. Provide lever operated pressure lubricated plug type gas shut-off

valve conforming to CGA 3.11-M88.

2.2.10 Insulating Pipe Joints

2.2.10.1 Insulating Joint Material

Provide insulating joint material between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.2.10.2 Threaded Pipe Joints

Provide threaded pipe joints of steel body nut type dielectric unions with insulating gaskets.

2.2.10.3 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. Provide lap joint flange pipe ends conforming to ASTM F2015.

2.2.11 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 LINE AND APPLIANCE REGULATORS AND SHUTOFF VALVES

Provide regulators conforming to ANSI Z21.18/CSA 6.3 for appliances and ANSI Z21.80/CSA 6.22 for line pressure regulators. Provide shutoff valves conforming to ANSI Z21.15/CSA 9.1 for manually controlled gas shutoff valves and ANSI Z21.21/CSA 6.5 for automatic shutoff valves for gas

appliances.

2.6 NATURAL GAS SERVICE

2.6.1 Service Regulators

a. Provide ferrous bodied pressure regulators for individual service lines, capable of reducing distribution line pressure to pressures required for users. Provide service regulators conforming to AGA ANSI B109.4 CGA-6.18-M95 with full capacity internal relief and overpressure shutoff. Set pressure relief at a lower pressure than would cause unsafe operation of any connected user.

b. Provide regulator(s) having a single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas flow rate at the regulator inlet pressure. Provide regulator valve vent of resilient materials designed to withstand flow conditions when pressed against the valve port, capable of regulating downstream pressure within limits of accuracy and limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Provide a self-contained service regulator, and pipe not exceeding 2 inch size.

2.6.2 Gas Meter

AGA ANSI B109.2 pipe mounted, diaphragm, cast-iron case. Provide diaphragm-type meter conforming to AGA ANSI B109.1 for required flow rates less than 500 cfh, or AGA ANSI B109.2, for flow rates 500 cfh and above as required by local gas utility supplier. Provide combined odometer-type register totalizer index, UV-resistant index cover, water escape hole in housing, and means for sealing against tampering. Provide temperature-compensated type meters sized for the required volumetric flow rate and suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated. Provide meters with over-pressure protection as specified in 49 CFR 192 and ASME B31.8. Provide meters that are tamper-proof with seismic protection. Provide meters with a pulse switch initiator capable of operating up to speeds of 500 maximum pulses per minute with no false pulses and requiring no field adjustments. Provide not less than one pulse per 100 cubic feet of gas. Minimum service life must be 30,000,000 cycles.

2.6.2.1 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.

2.6.2.2 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.

2.7 AUTOMATIC GAS SHUT-OFF

Provide low pressure automatic gas shutoff or excess flow valve (EFV) 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. The EFV may be either a bypass (automatic reset) or a non-bypass type (manual reset).

2.8 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.

2.9 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.10 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 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.

3.2.1 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.

3.2.2 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.

3.3 PROTECTIVE COVERING

3.3.1 Aboveground Metallic Piping Systems

3.3.1.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer. Solvent clean surfaces that have not been shop primed . Mechanically clean surfaces that contain loose rust, loose mill scale and other foreign substances by power wire brushing and prime with ferrous metal primer. Finish primed surfaces with two coats of exterior vinyl paint.

3.4 INSTALLATION

Install the gas system in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54, 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.

3.4.1 Metallic Piping Installation

Bury underground piping a minimum of 18 inches below grade. 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. Do not use aluminum alloy pipe in exterior locations or underground.

3.4.2 Metallic Tubing Installation

Install metallic tubing using gas tubing fittings approved by the tubing manufacturer. CSST gas piping systems must be installed by contractors who have completed the manufacturer's training program as indicated on a certification card. Make branch connections with tees. Prepare all tubing ends with tools designed for that purpose. Do not use aluminum alloy tubing in exterior locations or underground. Maintain electrical continuity of gas piping system in accordance with NFPA 54, paragraph entitled 'Electrical Bonding and Grounding'.

3.4.3 Concealed Piping in Buildings

Do not use combinations of fittings (unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints) to conceal piping within buildings.

3.4.3.1 Piping and Tubing in Partitions

Locate concealed piping and tubing in hollow, rather than solid,

partitions. Protect tubing passing through walls or partitions against physical damage both during and after construction, and provide appropriate safety markings and labels. Provide protection of concealed pipe and tubing in accordance with ANSI LC 1/CSA 6.26.

3.4.4 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.

3.4.5 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.

3.4.6 Seismic Requirements

Support and brace piping and attached valves to resist seismic loads in conformance with ASCE 25-16 and as specified in UFC 3-301-01, and Sections 13 48 73 BRACING FOR MISCELLANEOUS EQUIPMENT and 23 05 48.19 SEISMIC BRACING FOR HVAC. CSST tubing and fittings that are seismically qualified in accordance with the FM APP GUIDE: Flexible Piping Systems for Flammable Gases must meet the seismic requirements in accordance with the manufacturer's installation instructions.

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.

### 3.5.3 Flared Metallic Tubing Joints

Make flared joints in metallic tubing with special tools recommended by the tubing manufacturer. Use flared joints only in systems constructed from nonferrous pipe and tubing, when experience or tests have demonstrated that the joint is suitable for the conditions, and when adequate provisions are made in the design to prevent separation of the joints. Do not use metallic ball sleeve compression-type tubing fittings for tubing joints.

### 3.5.4 Solder or Brazed Joints

Make all joints in metallic tubing and fittings with materials and procedures recommended by the tubing supplier. Braze joints with material having a melting point above 1000 degrees F, containing no phosphorous.

## 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 FIRESTOPPINGG.

## 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 54NFPA 58.

## 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 Line

Install service line, branch connection to the main, and riser in accordance with 49 CFR 192 and ASME B31.8. Provide a minimum of 18 inches cover or encase the service line so that it is protected. Install service line so that no undue stress is applied to the pipe, connection, or riser. Install approved riser and terminate with an approved isolation valve, EFV and automatic shutoff device. After laying of pipe and testing, backfill the trench in accordance with Section 31 00 00 EARTHWORK.

Were steel pipe is used as service line, install corrosion prevention coating and cathodic protect for the steel service line. Where connected to an existing cathodically protected steel pipe, ensure electrical continuity from the riser to the branch connection to the main. Install a dielectric fitting on the riser to prevent electrical continuity to the above ground piping.

3.16.2 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.

3.16.3 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 --

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HYDRONIC PUMPS
**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 SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B1.1 | (2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form) |
| ASME B16.1 | (2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250 |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A48/A48M | (2003; R 2021) Standard Specification for Gray Iron Castings |
| 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 |

HYDRAULIC INSTITUTE (HI)

| | |
|---|---|
| HI 1.1-1.2 | (2014) Rotodynamic (Centrifugal) Pump for Nomenclature and Definitions |
| HI 1.3 | (2013) Rotodynamic (Centrifugal) Pump Applications |
| HI 9.6.4 | (2009) Rotodynamic Pumps for Vibration Analysis and Allowable Values |
| HI ANSI/HI 2.1-2.2 | (2014) Rotodynamic Vertical Pumps of Radial, Mixed, and Axial Flow Types for Nomenclature and Definitions |
| HI ANSI/HI 9.6.3 | (2017) Rotodynamic Pumps - Guideline for Operating Regions - B120 |
| HI ANSI/HI 14.6 | (2011) Rotodynamic Pumps for Hydraulic Performance Acceptance Tests - A136 |

INTERNATIONAL CODE COUNCIL (ICC)

| | |
|---|---|
| ICC IgCC | (2021) International Green Construction Code |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA MG 1 | (2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31 |
| NEMA Z535.4 | (2011; R 2017) Product Safety Signs and Labels |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

| | |
|---|---|
| SSPC Paint 21 | (1982; E 2004) White or Colored Silicone Alkyd Paint (Type I, High Gloss and Type II, Medium Gloss) |
| 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. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.219 | Mechanical Power Transmission Apparatus |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 778 | (2016; Reprint Jun 2021) UL Standard for Safety Motor-Operated Water Pumps |

## 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

System Coordination; G-AE

SD-03 Product Data

Instructions; G-AE

Equipment Data; G-AE

Training Period; G-AE

SD-06 Test Reports

Factory Tests

Field Quality Control

SD-07 Certificates

Manufacturer's Representative

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G-RO

Training; G-RO

1.3 QUALITY ASSURANCE

1.3.1 Manufacturer Services

Provide the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative must supervise the installation, adjustment, testing of the equipment, and conduct training.

Submit the names and qualifications of the manufacturer's representative and training engineers and written certification from the manufacturer that the representative and trainers are technically qualified.

1.3.2 Standard Products

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate equipment that has been in satisfactory HVAC operation at least 2 years prior to issuance of this solicitation. Support equipment with a service organization that is reasonably convenient to the jobsite. Pumps of the same types must each be the product of one manufacturer.

1.3.3 Conformance with Agency Requirements

Where materials or equipment are specified to be an approved type, attach the seal or label of approval from a nationally recognized testing agency, adequately equipped and competent to perform such services. A written certificate from the testing agency must accompany the materials or equipment and be submitted stating that the items have been tested and that they conform to the applicable requirements of the specifications and to the standards listed herein. The certificate must indicate the methods of testing used by the testing agency. In lieu of a certificate from a testing agency, published catalog specification data, accompanied by the manufacturer's certified statement to the effect that the items are in accordance with the applicable requirements of the specifications and the referenced standards, will be considered and may be acceptable as evidence that the items conform with agency requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect equipment, delivered and designated for storage, from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

Hydronic pumps used for heating and air conditioning applications are defined by the type of impeller, number of impellers, type of casing, method of connection to the driver, and mounting position. Provide centrifugal water pumps of the types indicated and specified. Use an electric motor driving unit for each pump as indicated and specified.

#### 2.1.1 Selection Criteria

Select pumps at a point within the maximum efficiency for a given impeller casing combination. Deviations within 3 percent of maximum efficiency are permissible, provided the lesser efficiency is not less than the scheduled efficiency in the construction design documents. Pumps having impeller diameters larger or smaller than manufacturer's published maximum and minimum impeller diameters for a given impeller casing combination will be rejected. Pump performance data, as shown in performance curves, must be based on factory tests using precision instrumentation and exacting procedures as detailed in HI ANSI/HI 14.6.

#### 2.1.2 System Coordination

Submit drawings containing complete wiring and piping schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show the proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation. Provide a complete listing of equipment, materials and miscellaneous components including mechanical seals, bearings, and couplings.

#### 2.1.3 Safety Requirements

Fully enclose or guard couplings, projecting set-screws, keys, and other rotating parts, that pose an entangling hazards..

### 2.2 MATERIALS AND EQUIPMENT

#### 2.2.1 Nameplates

Securely affix a standard nameplate to pumps and motors in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, for each pump show the capacity in gpm at rated speed in rpm and total head in feet of water. For each electric motor show at least the minimum information required by NEMA MG 1. Show such other information as the manufacturer may consider necessary to complete identification on the nameplate. Pumps must be listed and labeled by UL, and comply with UL 778 for pumps not using universal motors rated more than 250 volts such as circulating pumps.

#### 2.2.2 Framed Instructions

Submit proposed diagrams, instructions, and other sheets, prior to posting. Post approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, where directed. Provide 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, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. Post the framed instructions before acceptance testing of the systems.

2.2.3 Pump Characteristic

Construct hydronic water pumps in accordance with HI 1.1-1.2 and HI ANSI/HI 2.1-2.2. The pumps must be capable of discharging quantities at total discharge heads measured at the discharge flange, between the following limits:

Operate pumps at optimum efficiencies to produce the most economical pumping system under the conditions encountered and size to make optimum match with the system head curve as shown. Pumps must furnish not less than 150 percent of rated capacity at a total discharge head of not less than 65 percent of total rated head. The shutoff total head must not be greater than 120 percent of total rated head. Operate pumps at specified system fluid temperatures without vapor binding and cavitation. Operate pumps to HI ANSI/HI 9.6.3 standard for Preferred Operationg Region (POR).

2.2.4 Pump Drivers

Provide electric motors as indicated for each pump and in compliance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2.5 Equipment Data

Submit manufacturer's descriptive data and technical literature, performance charts and curves for all impeller sizes for a given casing, catalog cuts, and installation instructions. Provide spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than 2 months prior to the date of beneficial occupancy. Include a complete list of parts and supplies, with current unit prices and local source of supply with contact information.

Submit catalog information, certified pumps curves, rated capacities, final impeller dimensions, and accessories provided for the product indicated. Indicate operating point of each pump on curves. Furnish pump curves for each pump and combination of pumps designed to operate in parallel. The pump curve must show as a minimum; bhp, flow, total dynamic head, efficiency, NPSH, impeller diameter and system curve (individually and in combination for each pump operating in a parallel application). Select pumps operating in parallel operation to cross the system curve when operating individually.

2.3 HYDRONIC PUMPS

Provide centrifugal, single-stage type, or multi-stage type, designed for HVAC service in the following configurations:

| Configuration | Pump No. |
|---|---|
| Base-Mounted, Close Coupled, End Suction | _____ |

| Configuration | Pump No. |
|---|---|
| Automatic Cooling Coil Condensate Pump Units | _____ |

2.3.1 Base-Mounted, Flexible Coupled, End suction

Provide pumps with capacities as indicated; base mounted, separately-coupled, end suction designed with volute housing mounted to the frame to allow for pump service without relocating the motor or disturbing piping connections. Bearings and seals must be serviceable without disturbing piping. Pump must be factory hydrostatically tested in accordance with Hydraulic Institute standards and thoroughly cleaned.

2.3.1.1 Casing

Provide radially split pump casing ASTM A48/A48M Class 30 cast iron suitable for 175 psig working pressure with integral cast iron flanges drilled for ASME B16.1 ANSI Class 125 flanges, with an integrally-cast pedestal support foot. The pump volute must include gauge tappings at suction and discharge nozzles along with vent and drain tappings at top and bottom.

2.3.1.2 Pump Shaft

Carbon steel pump shaft with a replaceable stainless steel shaft sleeve completely covering the wetted area of the shaft under the seal.

2.3.1.3 Bearing

Incorporate maintenance free, permanently lubricated and sealed bearings in the pump bearing frame.

2.3.1.4 Seal Assembly

Equip with an integrally flushed mechanical seal assembly or a positive pressure external seal flushing line. Provide a mechanical seal with ceramic seal seat and carbon seal ring. Seal assembly must be rated up to 225 degrees F.

2.3.1.5 Baseplate

Baseplate must be of steel construction fully enclosed at sides and ends with welded cross members and fully open grouting area for field grouting. Minimum base plate stiffness must conform to HI 1.3 for horizontal baseplate design standards.

2.3.1.6 Coupler

Provide a flexible-type coupler between the pump and motor, capable of absorbing torsional vibration and variable speed operation between the pump and motor. The coupler must allow replacement with no need to move the hubs. Coupler must have natural rubber or neoprene type element materials with a maximum misalignment capability of 4 degrees angular and 0.125 inches parallel. Provide donut shaped elastomer element with preassembled flanges mechanically clamped to reinforced element and preassembled spacer center assembly. Secure flexible donut shaped element of coupler in place with radial clamp ring screws. Couplers must be rated

for required maximum rpm, horsepower and torque. The coupler must be shielded by a coupler guard securely fastened to the base. Provide coupler guard in compliance with current national safety standards including 29 CFR 1910.219 and NEMA Z535.4. Guards cannot have gaps greater than 0.250 inches, must be safety orange in color, and have an NEMA Z535.4 compliant warning label.

2.3.1.7 Impeller

Hydraulically and dynamically balance to HI 9.6.4 balance grade G6.3, closed, overhung, single suction, fabricate from cast bronze, key to shaft and secured by a locking capscrew.

2.3.1.8 Motor

Electric Motors must meet NEMA MG 1 and be the horsepower, speed, and voltage indicated. Motor enclosure must be open drip proof totally enclosed fan cooled. Motor must have heavy duty grease lubricated ball bearings completely adequate for the maximum load for which the motor is designed. Motor must be non-overloading at any point on the pump curve and premium efficiency. Provide motor efficiencies as shown in the ICC IgCC standard. Totally enclosed fan cooled motor efficiencies must comply with NEMA MG 1.

2.3.2 Cooling Coil Condensate Pump Units

Provide pumps with capacities as indicated. Cooling Coil Condensate Pump Unit must be a packaged unit including a corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory installed check valve and a 72 inch minimum, electrical power cord with plug for 120V/1PH/60HZ electrical service.

2.3.2.1 Motor

Electric motor must comply with NEMA MG 1 and be the size, voltage and enclosure indicated. Provide heavy duty grease lubricated ball bearings completely adequate for the maximum load for which the motor is designed.

2.4 ELECTRICAL WORK

Provide electrical motor driven equipment specified herein complete with motors, motor starters, and controls. Provide electric equipment and wiring in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics must be as indicated. Provide motor starters complete with properly sized thermal overload protection in each phase and other appurtenances necessary for the motor control specified. Each motor must be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage and frequency. Manual or automatic control and protective or signal devices required for the operation herein specified and any control wiring required for controls and devices but not indicated must be provided under this section of the specifications.

2.5 ELECTRICAL EQUIPMENT

Provide electrical equipment in conformance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical motor driven equipment herein specified complete with motors, motor starters, and controls. Motor

controls, equipment, and wiring must be in accordance with NFPA 70.

2.5.1 Electric Motors

Drive each electric motor-driven pump by a continuous-duty electric motor with enclosure type for specific service as defined in paragraph HYDRONIC PUMPS. Motor must have a 1.5 service factor. Provide synchronous motors having normal-starting-torque and low-starting-current characteristics, and of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. Integral size motors must be the premium efficiency type in accordance with NEMA MG 1. Pump electric motor efficiencies must meet or exceed the requirements of the ICC IgCC standard. Motor bearings must provide smooth operations under the conditions encountered for the life of the motor. Provide adequate thrust bearing in the motor to carry the weight of all rotating parts plus the hydraulic thrust and be capable of withstanding upthrust imposed during pump starting and under variable pumping head conditions specified. Motors must be rated 480 volts, 3 phase, 60 Hz and such rating must be stamped on the nameplate. Provide motors in conformance with NEMA MG 1.

2.5.2 Control Equipment

Automatically controlled pumps must have three-position "MANUAL-OFF-AUTOMATIC" selector switch in cover. Provide additional controls or protective devices as indicated.

2.5.3 Variable Speed Control

The variable speed motor controllers must meet the requirements of UFGS 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS.

2.6 EQUIPMENT APPURTENANCES

2.6.1 Attachments

Furnish all necessary bolts, nuts, washers, bolt sleeves, and other types of attachments with the equipment for the installation of the equipment. Bolts conform to the requirements of ASTM A307 and hexagonal nuts of the same quality as the bolts used. Threads must be clean-cut and conform to ASME B1.1. Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, must be zinc coated after being threaded, by the hot-dip process conforming to ASTM A153/A153M as appropriate. Bolts, nuts, and washers specified or indicated to be stainless steel must be Type 316.

2.6.2 Equipment Guards

Provide equipment driven by open shafts, belts, chains, or gears with all-metal guards enclosing the drive mechanism. Secure guards in position with steel braces or straps that permit easy removal for servicing the equipment. Coupler guards must comply with current national safety standards including 29 CFR 1910.219 and NEMA Z535.4. Provide guards with gaps no greater than 0.250 inches, safety orange in color, and have an NEMA Z535.4 compliant warning label.

2.6.3 Tools

Furnish a complete set of all special tools which may be necessary for the

adjustment, operation, maintenance, and disassembly of all equipment. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment. Special tools must be high-grade, smooth, forged, alloy, tool steel. Furnish one pressure grease gun for each type of grease required. Deliver all tools at the same time as the equipment to which they pertain. Properly store and safeguard such tools until completion of the work, at which time deliver them to the Contracting Officer.

## 2.7 FINISHES

All motors, pump casings, and similar parts of equipment must be thoroughly cleaned, primed, and given two finish coats of paint at the factory in accordance with the recommendations of the manufacturer. Give ferrous surfaces not to be painted a shop coat of grease or other suitable rust-resistant coating.

## 2.8 FACTORY TESTS

Pumps must be tested by the manufacturer or a nationally recognized testing agency in compliance with HI 1.3. Submit certified test results.

# 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

Install each pump and motor in accordance with the written instructions of the manufacturer and under the direct supervision of the manufacturer's representative. Provide access space around the device for servicing no less than the minimum recommended by the manufacturer.

### 3.2.1 Base Mounted, Long-Coupled Pumps

Set the pump baseplate as follows.

a. Place two sets of shims or wedges for each foundation bolt. Lower baseplate onto foundation bolts and level baseplate both lengthwise and across by adding or removing shims or mount wedges. A maximum difference of 0.125 inches lengthwise and 0.059 inches across is allowable.

b. Mount pump and driver on baseplate if not already mounted at factory. Pump and driver shafts must have initial cold (pump and driver at ambient temperature) alignment check and final hot (pump and driver at operating temperature) alignment check. Perform cold alignment check before baseplate is grouted, after baseplate is grouted, and after piping is connected. Perform final alignment check when pump and driver are at operating temperature. Move or shim only the driver to make adjustments to prevent strain on the piping installations. Initial alignment may be performed with scales, straight edges and calipers. Final alignment must be done with dial gauges or laser alignment devices. Final alignment misalignment may not exceed

coupling manufacturer's maximum parallel and angular misalignment values. When using variable frequency drives, reduce the manufacturer's misalignment values by 50 percent. Remove flexible coupling when performing alignment.

c. Support the connecting piping to ensure that there are no piping loads at the pump flange connections and connecting piping is not forced into position. Use concrete for equipment foundations as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE. Provide concrete foundations that are integral with and of the same class as that of the building floor unless otherwise indicated. Use concrete having a compressive strength of at least 2,500 psi in foundations that are entirely separated from the surrounding floor. Install a premolded filler strip between the foundation and floor slab as shown. Furnish foundation bolts, as required, for proper positioning during the placement of the concrete.

## 3.3 FIELD QUALITY CONTROL

After installation of the pumping units and appurtenances, including coupling guard, is complete, carry out operating tests to assure that the pumping installation operates properly. Make arrangements to have the manufacturer's representatives present when field equipment tests are made. Give each pumping unit a running field test in the presence of the Contracting Officer for a minimum of 2 hours. Operate each pumping unit at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer. Provide an accurate and acceptable method of measuring the discharge flow. Tests must assure that the units and appurtenances have been installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, correct such deficiencies and reconduct the tests.

Submit 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, upon completion and testing of the installed system. Each test report must indicate the final position of controls.

## 3.4 FIELD PAINTING

Do not paint stainless steel, galvanized steel, and nonferrous surfaces.

### 3.4.1 Touch-up painting

Factory painted items requiring touching up in the field must be thoroughly cleaned of all foreign material, and primed and topcoated with the manufacturer's standard factory finish.

### 3.4.2 Exposed Ferrous Surfaces

Paint exposed ferrous surfaces with two coats of enamel paint conforming to SSPC Paint 21. Solvent clean factory primed surfaces before painting. Surfaces that have not been factory primed must be prepared and primed with one coat of SSPC Paint 25 or in accordance with the enamel paint manufacturer's recommendations.

## 3.5 CLOSEOUT ACTIVITIES

### 3.5.1 Operation and Maintenance Manuals

Submit one complete set at the time the tests procedure is submitted; remaining sets before the contract is completed. Permanently bind each in a hard cover. Inscribe the following identification on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the building, name of the Contractor, and contract number. Place flysheets before instructions covering each subject. Use 8-1/2 by 11 inches paper for instruction sheets, with large sheets of drawings folded in.

Include, but do not limit to, the following in the Instructions:

a. System layout showing piping, valves, and controls.

b. Approved wiring and control diagrams including variable frequency drives.

c. A control sequence describing startup, operation, and shutdown.

d. Operating and maintenance instructions for each piece of equipment, including task list for routine maintenance, routine inspections, intermediate inspections, and annual inspections; lubrication instructions; and troubleshooting guide.

e. Manufacturer's bulletins, cuts, and descriptive data; and parts list and recommended spare parts.

### 3.5.2 Training

Upon completion of the work, and at a time designated by the Contracting Officer, provide the services of one or more competent engineers for a training period of not less than 3 hours to instruct a representative of the Government in the contents of the operation and maintenance manuals for the equipment furnished under these specifications. These field instructions must cover all the items contained in the bound instructions. Submit the training course curriculum and training instructions 14 days prior to the start of training.

-- End of Section --

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SECTION 23 23 00

REFRIGERANT PIPING
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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-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

| | |
|---|---|
| AHRI 710 I-P | (2009) Performance Rating of Liquid-Line Driers |
| AHRI 720 | (2002) Refrigerant Access Valves and Hose Connectors |
| AHRI 750 I-P | (2016) Performance Rating of Thermostatic Refrigerant Expansion Valves |
| AHRI 760 I-P | (2014) Performance Rating of Solenoid Valves for Use with Volatile Refrigerants |
| AHRI 1370 I-P | (2017) Performance Rating of Electronic Expansion Valves |

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

| | |
|---|---|
| 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 17 | (2015) Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves |
| ASHRAE 90.1 - IP | (2019; Errata 1 2019; Errata 2-6 2020; Addenda BY-CP 2020; Addenda AF-DB 2020; Addenda A-G 2020; Addenda F-Y 2021; Errata 7-8 2021; Interpretation 1-6 2021; Addenda AS-BF 2022) Energy Standard for Buildings Except Low-Rise Residential Buildings |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B16.22 | (2021) 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 |
| ASME B31.5 | (2020) Refrigeration Piping and Heat Transfer Components |
| ASME B40.100 | (2013) Pressure Gauges and Gauge Attachments |
| ASME BPVC SEC IX | (2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS A5.8/A5.8M | (2019) Specification for Filler Metals for Brazing and Braze Welding |
| AWS A5.31/A5.31M | (2012) Specification for Fluxes for Brazing and Braze Welding |
| AWS BRH | (2007; 5th Ed) Brazing Handbook |
| AWS Z49.1 | (2021) 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 A653/A653M | (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM B62 | (2017) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B75/B75M | (2020) Standard Specification for Seamless Copper Tube |
| 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 D3308 | (2012; R 2017) Standard Specification for PTFE Resin Skived Tape |
| ASTM E84 | (2020) Standard Test Method for Surface Burning Characteristics of Building 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 |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| UFC 3-301-01 | (2019, with Change 1, 2022) 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

Refrigerant Piping System; G-AE

SD-03 Product Data

Refrigerant Piping System

Spare Parts

Qualifications

Refrigerant Piping Tests

Verification of Dimensions

SD-06 Test Reports

Refrigerant Piping Tests

SD-07 Certificates

Service Organization

SD-10 Operation and Maintenance Data

Maintenance; G-RO

Operation and Maintenance Manuals; G-RO

Demonstrations; G-RO

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

Submit 3 copies of qualified procedures, and list of names and identification symbols of qualified welders and welding operators, prior to non-factory welding operations. Weld piping in accordance with the qualified procedures using performance qualified welders and welding

operators. Procedures and welders must 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. Notify the Contracting Officer 24 hours in advance of tests to be performed at the work site, if practical. The welder or welding operator must apply the personally assigned symbol near each weld made, as a permanent record.

1.3.2 Contract 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.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation is the Contractor's responsibility. Replace any materials found to be damaged at the Contractor's expense. During installation, cap piping and similar openings to keep out dirt and other foreign matter.

1.5 MAINTENANCE

1.5.1 General

Submit Data Package 2 plus operation and maintenance data complying with the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

1.5.2 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 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 in the data.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL 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 2 years prior to bid opening.

b. The 2 year use must include 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.

c. Products must be supported by a service organization. System components must be environmentally suitable for the indicated locations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. 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.

d. Exposed equipment 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. Install safety devices so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

e. Provide the manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component. Highlight the data to show information such as, but not limited to, material, size, options, performance charts, and curves in adequate detail to demonstrate compliance with contract requirements. Include the manufacturer's recommended installation instructions and procedures in the data provided. Provide data for the following components as a minimum:

(1) Piping and Fittings
(2) Valves
(3) Piping Accessories
(4) Pipe Hangers, Inserts, and Supports

## 2.2 REFRIGERANT PIPING SYSTEM

Provide refrigerant piping, valves, fittings, and accessories in accordance with ASHRAE 15 & 34 and ASME B31.5, except as specified herein. Refrigerant piping, valves, fittings, and accessories must be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service must be cleaned, dehydrated, and sealed (capped or plugged) prior to shipment from the manufacturer's plant. Submit drawings, at least 5 weeks prior to beginning construction, provided in adequate detail to demonstrate compliance with contract requirements. Drawings must consist of:

a. Piping layouts which identify all valves and fittings.

b. Plans and elevations which identify clearances required for maintenance and operation.

## 2.3 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

### 2.3.1 Copper Tubing

Provide copper tubing conforming to ASTM B280 annealed or hard drawn as required. Copper tubing must bear the product identification markings in

accordance with ASTM B280, "ACR" must be present on copper tubing. Copper tubing must be soft annealed where bending is required and hard drawn where no bending is required. Soft annealed copper tubing must not be used in sizes larger than 1-3/8 inches. Joints must be brazed except that joints on lines 7/8 inchand smaller may be flared. Cast copper alloy fittings for flared copper tube must conform to ASME B16.26 and ASTM B62. Wrought copper and bronze solder-joint pressure fittings must conform to ASME B16.22 and ASTM B75/B75M. Joints and fittings for brazed joint must be wrought-copper or forged-brass sweat fittings. Cast sweat-type joints and fittings are not 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.

2.3.2 Brazing Filler Metal

Filler metal must conform to AWS A5.8/A5.8M, Type BAg-5 with AWS Type FB3-A or Type FB3-C flux, except Type BCuP-3, BCuP-4, or BCuP-5 may be used for brazing copper-to-copper joints. BAlSi-4 with AWS Type FB1-A flux may be used when joining copper piping to aluminum components.

2.3.3 Brazing Flux

Brazing flux must conform to AWS A5.31/A5.31M, Type FB3-A or Type FB3-C when using Type BAg-5 filler metal. Type FB1-A is to be used with Type BAlSi-4 filler metal.

2.3.4 Press Fittings

Press fittings are not acceptable for use in refrigerant piping systems.

2.4 VALVES

Valves must be designed, manufactured, and tested specifically for refrigerant service. The valve material and all internal components must be compatible with the specific refrigerant and lubricant used. Valve bodies must be of brass, bronze, steel, or ductile iron construction. Valves 1 inch and smaller must have brazed or socket welded connections. Valves larger than 1 inch must have butt welded end connections. Do not use threaded end connections, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts must be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere must be stainless steel or corrosion resistant metal plated carbon steel. Direction of flow must be legibly and permanently indicated on the valve body. Control valve inlets must be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves must be of manufacturer's standard configuration.

2.4.1 Refrigerant Stop Valves

Valve must be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing must be replaceable under line pressure. Provide valve with a handwheel operator and a seal cap. Valve must be the straight or angle pattern design as indicated.

2.4.2 Check Valves

Valve must be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve must be provided with resilient seat.

2.4.3 Liquid Solenoid Valves

Provide valves that comply with AHRI 760 I-P and are suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves must be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions must be furnished. Provide solenoid coils that are moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves must have safe working pressure of 610 psi and a maximum operating pressure differential of at least 200 psi at 85 percent rated voltage. Valves must have an operating pressure differential suitable for the refrigerant used.

2.4.4 Expansion Valves

Provide valve conforming to AHRI 750 I-P and ASHRAE 17. Valve must be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Provide valve with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 2 degrees F of saturated suction temperature at evaporator conditions. Bulb charge must be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Do not use gas limited liquid charged valves and other valve devices for limiting evaporator pressure without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves must have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. Provide an isolatable pressure gauge in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicted or for constant evaporator loads.

2.4.5 Electronic Expansion Valves

Valve must conform to AHRI 1370 I-P and ASHRAE 17. The valve must prevent the return of liquid to the compressor in the event of power loss or low superheat.

2.4.6 Safety Relief Valves

Valve must be the two-way type, unless indicated otherwise. Valve must bear the ASME code symbol. Valve capacity must be certified by the National Board of Boiler and Pressure Vessel Inspectors. Valve must be of an automatically reseating design after activation.

2.4.7 Evaporator Pressure Regulators, Direct-Acting

Valve must include a diaphragm/spring assembly, external pressure

adjustment with seal cap, and pressure gauge port. Valve must maintain a constant inlet pressure by balancing inlet pressure on diaphragm against an adjustable spring load. Pressure drop at system design load must not exceed the pressure difference corresponding to a 2 degrees F change in saturated refrigerant temperature at evaporator operating suction temperature. Spring must be selected for indicated maximum allowable suction pressure range.

2.4.8 Refrigerant Access Valves

Provide refrigerant access valves and hose connections in accordance with AHRI 720.

2.5 PIPING ACCESSORIES

2.5.1 Filter Driers

Driers must conform to AHRI 710 I-P. Sizes 5/8 inch and larger must be the full flow, replaceable core type. Sizes 1/2 inch and smaller must be the sealed type. Cores must be of suitable desiccant that will not plug, cake, dust, channel, or break down, and must remove water, acid, and foreign material from the refrigerant. Constructfilter driers so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure must be 1,500 psi.

2.5.2 Sight Glass and Liquid Level Indicator

2.5.2.1 Assembly and Components

Assembly must be pressure- and temperature-rated and constructed of materials suitable for the service. Glass must be borosilicate type. Ferrous components subject to condensation must be electro-galvanized.

2.5.2.2 Gauge Glass

Gauge glass must include top and bottom isolation valves fitted with automatic checks, and packing followers; red-line or green-line gauge glass; elastomer or polymer packing to suit the service; and gauge glass guard.

2.5.2.3 Bull's-Eye and Inline Sight Glass Reflex Lens

Provide bull's-eye and inline sight glass reflex lens for dead-end liquid service. For pipe line mounting, provide two plain lenses in one body suitable for backlighted viewing.

2.5.2.4 Moisture Indicator

Indicator must be a self-reversible action, moisture reactive, color changing media. Indicator must be furnished with full-color-printing tag containing color, moisture, and temperature criteria. Unless otherwise indicated, the moisture indicator must be an integral part of each corresponding sight glass.

2.5.3 Vibration Dampeners

Dampeners must be of the all-metallic bellows and woven-wire type.

### 2.5.4 Flexible Pipe Connectors

Connector must be a composite of interior corrugated phosphor bronze or Type 300 Series stainless steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly must be constructed with a safety factor of not less than 4 at300 degrees F. Unless otherwise indicated, the length of a flexible connector must be as recommended by the manufacturer for the service intended.

### 2.5.5 Strainers

Strainers used in refrigerant service must have brass or cast-iron body, Y-or angle-pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than ten times the pipe diameter with pressure rating compatible with the refrigerant service. Screens must be stainless steel or monel and reinforced spring-loaded where necessary for bypass-proof construction.

### 2.5.6 Pressure and Vacuum Gauges

Provide gauges conforming to ASME B40.100 with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge must be a minimum of 3-1/2 inches in diameter with a range from 0 psig to approximately 1.5 times the maximum system working pressure. Select each gauge range so that at normal operating pressure, the needle is within the middle-third of the range.

### 2.5.7 Temperature Gauges

Provide industrial duty type temperature gauges for the required temperature range. Gauges must have Fahrenheit scale in 2 degrees graduations scale (black numbers) on a white face. The pointer must be adjustable. Provide rigid stem type temperature gauges in thermowells located within 5 feet of the finished floor. Provide universal adjustable angle type or remote element type temperature gauges in thermowells located 5 to 7 feet above the finished floor. Provide remote element type temperature gauges in thermowells located 7 feet above the finished floor.

#### 2.5.7.1 Stem Cased-Glass

Provide stem cased-glass case composed of polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

#### 2.5.7.2 Bimetallic Dial

Provide bimetallic dial type case that is greater than 3-1/2 inches, stainless steel, and hermetically sealed with clear acrylic lens. Bimetallic element must be silicone dampened and unit fitted with external calibrator adjustment. Accuracy must be one percent of dial range.

#### 2.5.7.3 Thermowell

Thermowell must be identical size, 1/2 or 3/4 inch NPT connection, brass or stainless steel. Where test wells are indicated, provide captive plug-fitted type 1/2 inch NPT connection suitable for use with either engraved stem or standard separable socket thermometer or thermostat. Mercury must not be used in thermometers. Extended neck thermowells must be of sufficient length to clear insulation thickness by 1 inch.

2.5.8 Pipe Hangers, Inserts, and Supports

Provide pipe hangers, inserts, guides, and supports conforming to MSS SP-58.

2.5.9 Escutcheons

Escutcheons must be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screws.

2.6 FABRICATION

2.6.1 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 500 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.

2.6.2 Factory Applied Insulation

Factory installed insulation must be in accordance with ASHRAE 90.1 - IP. Refrigerant suction lines between the cooler and each compressor must be insulated with not less than 1/2 inch thick unicellular plastic foam. 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. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Test material supplied by a manufacturer with a jacket as a composite material. Provide jackets, facings, and adhesives that have a flame spread index less than 25 and a smoke developed index less than 50 when tested in accordance with ASTM E84.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform a verification of dimensions in the field. Submit a letter, at least 2 weeks prior to beginning construction, including the date the site was visited, conformation of existing conditions, and any discrepancies found before performing any work.

3.2 INSTALLATION

Pipe and fitting installation must conform to the requirements of

ASME B31.1. Cut pipe accurately to measurements established at the jobsite, and work into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation is not permitted without written approval. Cut pipe or tubing square, remove by reaming, and permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers.

3.2.1 Directional Changes

Make changes in direction with fittings, except that bending of pipe 4 inches and smaller is permitted, provided a pipe bender is used and wide weep bends are formed. Mitering or notching pipe or other similar construction to form elbows or tees is not permitted. The centerline radius of bends must not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted.

3.2.2 Functional Requirements

Install piping 1/2 inch/10 feet of pipe in the direction of flow to ensure adequate oil drainage. Properly cap or plug open ends of refrigerant lines or equipment during installation to keep moisture, dirt, or other foreign material out of the system. Piping must remain capped until installation. Equipment piping must be in accordance with the equipment manufacturer's recommendations and the contract drawings. Equipment and piping arrangements must fit into space allotted and allow adequate acceptable clearances for installation, replacement, entry, servicing, and maintenance.

3.2.3 Fittings and End Connections

3.2.3.1 Threaded Connections

Make threaded connections with tapered threads and make tight with PTFE tape complying with ASTM D3308 or equivalent thread-joint compound applied to the male threads only. Do not show more than three threads after the joint is made.

3.2.3.2 Brazed Connections

Perform brazing in accordance with AWS BRH, except as modified herein. During brazing, fill the pipe and fittings with a pressure regulated inert gas, such as nitrogen, to prevent the formation of scale. Before brazing copper joints, clean both the outside of the tube and the inside of the fitting with a wire fitting brush until the entire joint surface is bright and clean. Do not use brazing flux on copper-to-copper connections. Remove surplus brazing material at all joints. Make steel tubing joints in accordance with the manufacturer's recommendations. Paint joints in steel tubing with the same material as the baked-on coating within 8 hours after joints are made. Protect tubing against oxidation during brazing by continuous purging of the inside of the piping using nitrogen. Support piping prior to brazing and do not spring or force.

3.2.3.3 Flared Connections

When flared connections are used, use a suitable lubricant between the back of the flare and the nut in order to avoid tearing the flare while tightening the nut.

### 3.2.4 Valves

#### 3.2.4.1 General

Install refrigerant stop valves 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. Install stop valves with stems horizontal unless otherwise indicated. Install ball valves must be installed with stems positioned to facilitate operation and maintenance. Isolating valves for pressure gauges and switches must be external to thermal insulation. Safety switches must not be fitted with isolation valves. Filter dryers having access ports may be considered a point of isolation. Purge valves must be provided at all points of systems where accumulated non-condensable gases would prevent proper system operation. Valves must be furnished to match line size, unless otherwise indicated or approved.

#### 3.2.4.2 Expansion Valves

Install expansion valves 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. Fasten the bulb securely with two clamps. Insulate ehe bulb . Install the bulb 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 must be facing up.

#### 3.2.4.3 Valve Identification

Tag each system valve, including those which are part of a factory assembly. Tags must be in alphanumeric sequence, progressing in direction of fluid flow. Tags must be embossed, engraved, or stamped plastic or nonferrous metal of various shapes, sized approximately 1-3/8 inch diameter, or equivalent dimension, substantially attached to a component or immediately adjacent thereto. Attach tags with nonferrous, heavy duty, bead or link chain, 14 gauge annealed wire, nylon cable bands or as approved. Reference tag numbers in Operation and Maintenance Manuals and system diagrams.

### 3.2.5 Vibration Dampers

Provide vibration damper in the suction and discharge lines on spring mounted compressors. Install vibration dampers parallel with the shaft of the compressor and anchor firmly at the upstream end on the suction line and the downstream end in the discharge line.

### 3.2.6 Strainers

Provide strainers immediately ahead of solenoid valves and expansion devices. Strainers may be an integral part of an expansion valve.

### 3.2.7 Filter Dryer

Provide a liquid line filter dryer on each refrigerant circuit located such that all liquid refrigerant passes through a filter dryer. Size dryers in accordance with the manufacturer's recommendations for the

system in which it is installed. Install dryers such that it can be isolated from the system, the isolated portion of the system evacuated, and the filter dryer replaced. Install dryers in the horizontal position except replaceable core filter dryers may be installed in the vertical position with the access flange on the bottom.

3.2.8 Sight Glass

Install a moisture indicating sight glass in all refrigerant circuits down stream of all filter dryers and where indicated. Provide full line size sight glasses.

3.2.9 Discharge Line Oil Separator

Provide discharge line oil separator in the discharge line from each compressor. Connect the oil return line to the compressor as recommended by the compressor manufacturer.

3.2.10 Accumulator

Provide accumulators in the suction line to each compressor.

3.2.11 Flexible Pipe Connectors

Install connectors perpendicular to line of motion being isolated. Fit piping for equipment with bidirectional motion with two flexible connectors, in perpendicular planes. Install reinforced elastomer flexible connectors in accordance with manufacturer's instructions. Provide piping guides and restraints related to flexible connectors as required.

3.2.12 Temperature Gauges

Locate temperature gauges specifically on, but not limited to the following: the sensing element of each automatic temperature control device where a thermometer is not an integral part thereof and the suction line at each evaporator or liquid cooler. Thermowells for insertion thermometers and thermostats must extend beyond thermal insulation surface not less than 1 inch.

3.2.13 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports must conform to MSS SP-58, except as modified herein. Do not use pipe hanger types 5, 12, and 26. Fabricate hangers used to support piping 2 inches and larger to permit adequate adjustment after erection while still supporting the load. Support piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, by variable spring hangers and supports or by constant support hangers.

3.2.13.1 Hangers

Do not use Type 3 on insulated piping. Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.2.13.2 Inserts

Secure Type 18 inserts to concrete forms before concrete is placed. Continuous inserts which allow more adjustments may be used if they

otherwise meet the requirements for Type 18 inserts.

3.2.13.3 C-Clamps

Torque Type 19 and 23 C-clamps in accordance with MSS SP-58 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

3.2.13.4 Angle Attachments

Furnish Type 20 attachments used on angles and channels with an added malleable-iron heel plate or adapter.

3.2.13.5 Saddles and Shields

Where Type 39 saddle or Type 40 shield are permitted for a particular pipe attachment application, the Type 39 saddle, connected to the pipe, must be used on all pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Use Type 40 shields on all piping less than 4 inches and all piping 4 inches and larger carrying medium less than 60 degrees F. Use a high-density insulation insert of cellular glass under the Type 40 shield for piping 2 inches and larger.

3.2.13.6 Horizontal Pipe Supports

Space horizontal pipe supports as specified in MSS SP-58 and install a support no more than 1 foot from the pipe fitting joint at each change in direction of the piping. Space pipe supports no more than 5 feet apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 50 pounds must have the excess hanger loads suspended from panel points.

3.2.13.7 Vertical Pipe Supports

Support vertical pipe at each floor, except at slab-on-grade, and at intervals of not more than 15 feet not more than 8 feet from end of risers, and at vent terminations.

3.2.13.8 Pipe Guides

Provide Type 35 guides using, steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides where required to allow longitudinal pipe movement. Provide lateral restraints as required. Provide slide materials that are suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

3.2.13.9 Steel Slides

Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, usea Type 39 saddle. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.

3.2.13.10 High Temperature Guides with Cradles

Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide must include a pipe cradle, welded to the guide structure and strapped securely to the pipe. Separate the pipe from

the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.

3.2.13.11 Multiple Pipe Runs

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 must not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.2.13.12 Seismic Requirements

Support and brace piping and attached valves to resist seismic loads as specified under UFC 3-301-01 and Sections 13 48 73 BRACING FOR MISCELLANEOUS EQUIPMENT and 23 05 48.19 SEISMIC BRACING FOR HVAC. Provide structural steel required for reinforcement to properly support piping, headers, and equipment but not shown under this section. Specify material used for support under Section 05 12 00 STRUCTURAL STEEL.

3.2.13.13 Structural Attachments

Attachment to building structure concrete and masonry must be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors must be applied with a safety factor not less than 5. Do not attach supports to metal decking. Construct masonry anchors for overhead applications of ferrous materials only. Provide structural steel brackets required to support piping, headers, and equipment, but not shown, under this section. Specify material used for support under Section 05 12 00 STRUCTURAL STEEL.

3.2.14 Pipe Alignment Guides

Provide pipe alignment guides where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 5 feet on each side of each expansion joint, and in lines 4 inches or smaller not more than 2 feet on each side of the joint.

3.2.15 Pipe Anchors

Provide anchors wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Provide anchors consisting of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Install anchor braces in the most effective manner to secure the desired results using turnbuckles where required. Do not attach supports, anchors, or stays where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline. Where pipe and conduit penetrations of vapor barrier sealed surfaces occur, immediately anchor these items adjacent to each penetrated surface, to provide essentially zero movement within penetration seal. Submit detailed drawings of pipe anchors for approval before installation.

3.2.16 Building Surface Penetrations

Do not install sleeves in structural members except where indicated or approved. Provide galvanized sheet metal sleeves in non-load bearing surfaces conforming to ASTM A653/A653M, Coating Class G-90, 20 gauge. Provide uncoated carbon steel pipe sleeves in load bearing surfaces conforming to ASTM A53/A53M, Standard weight. Apply sealants to moisture

and oil-free surfaces and elastomers to not less than 1/2 inch depth. Do not install sleeves in structural members.

3.2.16.1 Refrigerated Space

Fit refrigerated space building surface penetrations with sleeves fabricated from hand-lay-up or helically wound, fibrous glass reinforced polyester or epoxy resin with a minimum thickness equal to equivalent size Schedule 40 steel pipe. Construct sleeves with integral collar or fit cold side with a bonded slip-on flange or extended collar. In the case of masonry penetrations where sleeve is not cast-in, fill voids with latex mixed mortar cast to shape of sleeve and assemble flange/external collar type sleeve with butyl elastomer vapor barrier sealant through penetration to cold side surface vapor barrier overlap and fastened to surface with masonry anchors. Flash integral cast-in collar type sleeve. Normally seal noninsulated penetrating round surfaces to sleeve bore with mechanically expandable seals in vapor tight manner and insulate remaining warm and cold side sleeve depth with not less than 4 inches of foamed-in-place rigid polyurethane or foamed-in-place silicone elastomer. Apply vapor barrier sealant to finish warm side insulation surface. Insulate warm side of penetrating surface beyond vapor barrier sealed sleeve insulation for a distance which prevents condensation. Seal wires in refrigerated space surface penetrating conduit with vapor barrier plugs or compound to prevent moisture migration through conduit and condensation therein.

3.2.16.2 General Service Areas

Extend each sleeve through its respective wall, floor, or roof, and cut flush with each surface. Provide pipes passing through concrete or masonry wall or concrete floors or roofs with pipe sleeves fitted into place at the time of construction. Provide sleeves that allow a minimum of 1/4 inch all-around clearance between bare pipe and sleeves or between jacketed-insulation and sleeves. Except in pipe chases or interior walls, seal the annular space between pipe and sleeve or between jacket over-insulation and sleeve in accordance with Section 07 92 00 JOINT SEALANTS.

3.2.16.3 Waterproof Penetrations

Install pipes passing through roof or floor waterproofing membrane through a 17 ounce copper sleeve, or a 0.032 inch thick aluminum sleeve, each within an integral skirt or flange. Form flashing sleeve, and extend skirt or flange greater than 8 inches from the pipe and set over the roof or floor membrane in a troweled coating of bituminous cement. Extend the flashing sleeve up the pipe a minimum of 2 inches above the roof or floor penetration. Seal the annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation as indicated. Seal penetrations by either one of the following methods.

3.2.16.3.1 Waterproofing Clamping Flange

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. Clamp waterproofing membrane into place and place sealant in the caulking recess.

3.2.16.3.2 Modular Mechanical Type Sealing Assembly

In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Provide seals consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Loosely assemble links 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, tighten the bolt to cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Size each seal assembly as recommended by the manufacturer to fit the pipe/conduit and sleeve involved. The Contractor electing to use the modular mechanical type seals must provide sleeves of the proper diameters.

3.2.16.4 Fire-Rated Penetrations

Seal penetration of fire-rated walls, partitions, and floors as specified in Section 07 84 00 FIRESTOPPING.

3.2.16.5 Escutcheons

Provide escutcheons for finished surfaces where exposed piping, bare or insulated, pass through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Where sleeves project slightly from floors, use special deep-type escutcheons. Secure escutcheon to pipe or pipe covering.

3.2.17 Access Panels

Provide access panels for all concealed valves, vents, controls, and items requiring inspection or maintenance. Provide access panels of sufficient size and locate so that the concealed items may be serviced and maintained or completely removed and replaced. Provide access panels as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

3.2.18 Field Applied Insulation

Field installed insulation is specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.2.19 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.

3.2.19.1 Color Coding

Color coding for piping identification is specified in Section 09 90 00 PAINTS AND COATINGS.

3.2.20 Identification Tags

Provide identification tags made of brass, engraved laminated plastic or engraved anodized aluminum indicating service and item number on all valves and dampers. Tags must be 1-3/8 inch minimum diameter and marking

must be stamped or engraved. Indentations must be black for reading clarity. Attach tags to valves with No. 12 AWG copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.3 CLEANING AND ADJUSTING

Clean uncontaminated system(s) by evacuation and purging procedures currently recommended by refrigerant and refrigerant equipment manufacturers, and as specified herein, to remove small amounts of air and moisture. Systems containing moderate amounts of air, moisture, contaminated refrigerant, or any foreign matter are considered contaminated systems. Restore contaminated systems to clean condition including disassembly, component replacement, evacuation, flushing, purging, and re-charging, using currently approved refrigerant and refrigeration manufacturer's procedures. Restore contaminated systems at no additional cost to the Government as determined by the Contracting Officer. Do not use water in any procedure or test.

3.4 TRAINING COURSE

a. Submit a schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training. Conduct a training course for 4 members of the operating staff as designated by the Contracting Officer. The training period must consist of a total 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests.

b. Cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations in the field posted instructions..

c. Submit 6 complete copies of an operation manual 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 at least 4 weeks prior to the first training course. Include the manufacturer's name, model number, and parts list in the booklets. Include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features in the manuals.

d. Submit 6 complete copies of maintenance manual in bound 8 1/2 x 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. Include piping layouts and simplified wiring and control diagrams of the system as installed in the manuals.

3.5 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. Coordinate field tests 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. Include initial test summaries, all repairs/adjustments made, and the final test results in the report.

3.5.1 Preliminary Procedures

Prior to pneumatic testing, isolate 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, from the test pressure, or remove from the system. Remove safety relief valves and rupture discs that are not part of factory sealed systems, and cap or plug openings.

3.5.2 Pneumatic Test

Provide pressure control and excess pressure protection at the source of test pressure. Valves must be wide open, except those leading to the atmosphere. Test gas must be dry nitrogen, with minus 70 degree F dewpoint and less than 5 ppm oil. Apply test pressure in two stages before any refrigerant pipe is insulated or covered. In accordance with ASME B31.5, a preliminary test not to exceed 25 psi must be applied as a means of locating major leaks. Every joint being tested must be coated with a thick soap or color indicating solution. The second stage test pressure must be at least 110 percent of the design pressure, but cannot exceed 130 percent of the design pressure of any component in the system. For large systems that are not completely visible, the pressure in the system must be gradually increased to one-half of the test pressure after which the pressure must be increased in steps of one-tenth of the test pressure, until the required test pressure has been reached. The test pressure must be continuously maintained for at leas 24 hours, after which it can be reduced to the leak test pressure. 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. The leak test pressure must be the design pressure, or a pressure specified in the engineering design. To repair leaks, the joint must be taken apart, thoroughly cleaned, and reconstructed as a new joint. Joints repaired by caulking, re-melting, or back-welding/brazing are not acceptable. Following repair, the entire system must be retested using the pneumatic tests described above. Reassemble the entire system once the pneumatic tests are satisfactorily completed.

3.5.3 Evacuation Test

Following satisfactory completion of the pneumatic tests, relieve the pressure and evacuate the entire system to an absolute pressure of 300 micrometers. During evacuation of the system, the ambient temperature must be higher than 35 degrees F. Do not evacuate no more than one system at one time by one vacuum pump. Once the desired vacuum has been reached, close the vacuum line and allow the system to stand for 1 hour. If the pressure rises over 500 micrometers after the 1 hour period, evacuate the system again down to 300 micrometers and let set for another 1 hour period. Do not charge the system 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 rises above 500 micrometers, continue to repeat the evacuation procedures until all residual moisture has been removed. During evacuation, record pressures by a thermocouple-type, electronic-type, or a calibrated-micrometer type

gauge.

3.5.4 System Charging and Startup Test

Following satisfactory completion of the evacuation tests, charge the system with the required amount of refrigerant by raising pressure to normal operating pressure and in accordance with manufacturer's procedures. Following charging, the system must operate with high-side and low-side pressures and corresponding refrigerant temperatures, at design or improved values. Test the entire system tested for leaks. Test fluorocarbon systems with halide torch or electronic leak detectors.

3.5.5 Refrigerant Leakage

If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system must be immediatelyisolated from the remainder of the system and the refrigerant pumped into the system receiver or other suitable container. The refrigerant must not be discharged into the atmosphere.

3.5.6 Contractor's Responsibility

At all times during the installation and testing of the refrigeration system, take steps 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 will the allowable leak rate exceed the leak rates allowed in Section 608 of the Clean Air Act: 30 percent of the full charge per year for industrial refrigeration, 20 percent of the full charge per year for commercial refrigeration, and 10 percent of the full charge per year for comfort cooling. 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.

-- End of Section --

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SECTION 23 25 00

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**05/21**

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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 | (2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31 |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| EM 200-1-13 | (2016) Environmental Quality -- Minimizing the Risk of Legionellosis Associated with Building Water Systems on Army 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-03 Product Data

Water Treatment System; G-AE

Water Analysis; G-AE

Spare Parts

Field Instructions

Tests; G-AE

Training Course; G-RO

SD-10 Operation and Maintenance Data

Water Treatment System

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 3 months 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. Minimize to risk of Legionellosis by following the guidance in EM 200-1-13.

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.

d. The selected service organization provides the chemicals required, the concentrations required, and the water treatment equipment sizes and flow rates required. The company provides all chemicals required for the heating hot water systems and fills the systems with chemicals to the levels specified. The chemical is required to meet the requirements of this specification as well as the recommendations from the manufacturers of the boiler. Acid treatment chemicals are not allowed to be used.

2.1.3 Water Analysis

Conditions of make-up water to be supplied to the boilers, reported in accordance with ASTM D596 are as follows:

| | |
|---|---|
| Date of Sample | _____ |
| Temperature | _____ degrees C |
| 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 5 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 System

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.

#### 2.3.1.3 Test Kit Requirements

Provide one test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals (e.g. pH and nitrite or molybdate).

### 2.3.2 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 | _____ |
| Nitrite or Molybdate | _____ ppm (mg/L) |

### 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.

-- End of Section --

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SECTION 23 30 00

HVAC AIR DISTRIBUTION
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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 MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

| | |
|---|---|
| AMCA 201 | (2002; R 2011) Fans and Systems |
| AMCA 210 | (2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating |
| AMCA 220 | (2005;R 2012) Test Methods for Air Curtain Units |
| 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 430 | (2009) Central-Station Air-Handling Units |
| 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 | (2019) Ventilation for Acceptable Indoor Air Quality |
| ASHRAE 70 | (2006; R 2021) Method of Testing the Performance of Air Outlets and Inlets |
| ASHRAE 90.1 - IP | (2019; Errata 1 2019; Errata 2-6 2020; Addenda BY-CP 2020; Addenda AF-DB 2020; Addenda A-G 2020; Addenda F-Y 2021; Errata 7-8 2021; Interpretation 1-6 2021; Addenda AS-BF 2022) Energy Standard for Buildings Except Low-Rise Residential Buildings |

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 | (2022) 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 B280 | (2020) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service |
| 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 C1071 | (2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material) |
| 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 | (2022) 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 | (2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31 |
| 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 | (2020) HVAC Duct Construction Standards Metal and Flexible, 4th 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 Dec 2021) UL Standard for Safety Factory-Made Air Ducts and Air Connectors |
| UL 555 | (2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers |
| UL 586 | (2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units |
| UL 705 | (2017; Reprint Aug 2021) 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 Electrical Construction | (2012) Electrical Construction Equipment 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.

1.2.2 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 |
|---|---|
| Air handling unit Number | AHU - _____ |
| Control and instrument air | CONTROL AND INSTR. |
| Exhaust Fan Number | EF - _____ |
| VAV Box Number | VAV - _____ |
| Fan Coil Unit Number | FC - _____ |

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:

a. Each point of entry and exit of pipe passing through walls.

b. Each change in direction, i.e., elbows, tees.

c. In congested or hidden areas and at all access panels at each point required to clarify service or indicated hazard.

d. 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-AE

SD-03 Product Data

Metallic Flexible Duct

Duct Connectors

Duct Access Doors; G-AE

Fire Dampers

Manual Balancing Dampers; G-AE

Sound Attenuation Equipment

Diffusers

Registers and Grilles

Louvers

Centrifugal Fans

In-Line Centrifugal Fans

Air-Curtain Fans

Air Handling Units; G-AE

Variable Volume, Single Duct Terminal Units; G-AE

Reheat Units; G-AE

Energy Recovery Devices; G-AE

Test Procedures

Indoor Air Quality for Duct Sealants

SD-06 Test Reports

Performance Tests; G-RO

Damper Acceptance Test; G-RO

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-RO

Fire Dampers; G-RO

Manual Balancing Dampers; G-RO

Centrifugal Fans; G-RO

In-Line Centrifugal Fans; G-RO

Air Handling Units; G-RO

Variable Volume, Single Duct Terminal Units; G-RO

Reheat Units; G-RO

Energy Recovery Devices; G-RO

SD-11 Closeout Submittals

Indoor Air Quality During Construction

## 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 hot-dip galvanized ferrous 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.

1.4.5 Test Procedures

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.

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.

## PART 2 PRODUCTS

### 2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-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. Provide equipment items that are supported by a service organization. In product categories covered by ENERGY STAR or the Federal Energy Management Program, provide equipment that is listed on the ENERGY STAR Qualified Products List or that meets or exceeds the FEMP-designated Efficiency Requirements.

### 2.2 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.

### 2.3 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.

### 2.4 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 00INTERIOR 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.

## 2.5 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.

## 2.6 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria for the area and as defined in SMACNA 1981

## 2.7 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. Paint in accordance with Section 09 90 00 PAINTS AND COATINGS.

## 2.8 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

## 2.9 DUCT SYSTEMS

### 2.9.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and

components, that complies with SMACNA 1966, as supplemented and modified by this specification .

a. Construct ductwork meeting the requirements for the duct system static pressure specified in APPENDIX D of Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.

b. 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.

c. 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.

d. 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.

e. 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.

f. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

2.9.1.1 Metallic Flexible Duct

a. Provide duct that conforms to UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Provide duct assembly that does not exceed 25 for flame spread and 50 for smoke developed. Provide ducts designed for working pressures of 2 inches water gauge positive and 1.5 inches water gauge negative. Provide flexible round duct length that does not exceed 5 feet. Secure connections by applying adhesive for 2 inches over rigid duct, apply flexible duct 2 inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of zinc-coated steel, aluminum, or stainless steel; or constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

c. Insulation: Provide inner duct core that is insulated with mineral fiber blanket type flexible insulation, minimum of 1 inch thick.

Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.9.1.2 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.

2.9.2 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.

2.9.3 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.

2.9.4 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.

2.9.5 Air Supply And Exhaust Air Dampers

Provide outdoor air supply and exhaust air dampers that have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP, including maximum Damper Leakage for:

a. The maximum damper leakage at 1.0 inch w.g. for motorized dampers is 3 cfm per square foot of damper area and non-motorized dampers are not allowed.

2.9.6 Air Deflectors (Volume Extractors) and Branch Connections

Provide air deflectors (volume extractors) at all duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections are allowed in lieu of deflectors for branch connections. Furnish all air deflectors (volume extractors), except those installed in 90 degree elbows, with an approved means of adjustment. Provide easily accessible means for adjustment inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, provide external adjustments with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Provide factory-fabricated air deflectors consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Provide factory or field assembled air deflectors (volume extractors). Make adjustment from the face of the diffuser or by position adjustment and lock external to the duct. Provide stand-off brackets on insulated ducts as described herein. Provide fixed air deflectors (volume extractors), also called turning vanes, in 90 degree elbows.

2.9.7 Plenums and Casings for Field-Fabricated Units

2.9.7.1 Plenum and Casings

Fabricate and erect plenums and casings as shown in SMACNA 1966, as applicable. Construct system casing of not less than 16 gauge galvanized sheet steel. Furnish cooling coil drain pans with 1 inch threaded outlet to collect condensation from the cooling coils. Fabricate drain pans from not lighter than 16 gauge steel, galvanized after fabrication or of 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304, welded and stiffened. Thermally insulate drain pans exposed to the atmosphere to prevent condensation. Coat insulation with a flame resistant waterproofing material. Provide separate drain pans for each

vertical coil section, and a separate drain line for each pan. Size pans to ensure capture of entrained moisture on the downstream-air side of the coil. Seal openings in the casing, such as for piping connections, to prevent air leakage. Size the water seal for the drain to maintain a pressure of at least 2 inch water gauge greater than the maximum negative pressure in the coil space.

2.9.7.2 Casing

Terminate casings at the curb line and bolt each to the curb using galvanized angle, as indicated in SMACNA 1966.

2.9.7.3 Access Doors

Provide access doors in each section of the casing. 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.

2.9.7.4 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.

2.9.7.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.9.8 Sound Attenuation Equipment

2.9.8.1 Systems with total pressure above 4 Inches Water Gauge

Provide sound attenuators on the discharge duct of each fan operating at a total pressure above 4 inch water gauge, and, when indicated, at the intake of each fan system. Provide sound attenuators elsewhere as indicated. Provide factory fabricated sound attenuators, tested by an independent laboratory for sound and performance characteristics. Provide a net sound reduction as indicated. Maximum permissible pressure drop is not to exceed 0.63 inch water gauge. Construct traps to be airtight when operating under an internal static pressure of 10 inch water gauge. Provide air-side surface capable of withstanding air velocity of 10,000 fpm. Certify that the equipment can obtain the sound reduction values specified after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Provide sound

absorbing material conforming to ASTM C1071, Type I or II. Provide sound absorbing material that meets the fire hazard rating requirements for insulation specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. For connection to ductwork, provide a duct transition section. Factory fabricated double-walled internally insulated spiral lock seam and round duct and fittings designed for high pressure air system can be provided if complying with requirements specified for factory fabricated sound attenuators, in lieu of factory fabricated sound attenuators. Construct the double-walled duct and fittings from an outer metal pressure shell of zinc-coated steel sheet, 1 inch thick acoustical blanket insulation, and an internal perforated zinc-coated metal liner. Provide a sufficient length of run to obtain the noise reduction coefficient specified. Certify that the sound reduction value specified can be obtained within the length of duct run provided. Provide welded or spiral lock seams on the outer sheet metal of the double-walled duct to prevent water vapor penetration. Provide duct and fittings with an outer sheet that conforms to the metal thickness of high-pressure spiral and round ducts and fittings shown in SMACNA 1966. Provide acoustical insulation with a thermal conductivity "k" of not more than 0.27 Btu/inch/square foot/hour/degree F at 75 degrees F mean temperature. Provide an internal perforated zinc-coated metal liner that is not less than 24 gauge with perforations not larger than 1/4 inch in diameter providing a net open area not less than 10 percent of the surface.

2.9.8.2 System with total pressure of 4 Inch Water Gauge and Lower

Use sound attenuators only where indicated. Provide factory fabricated sound attenuators that are constructed of galvanized steel sheets. Provide attenuator with outer casing that is not less than 22 gauge. Provide fibrous glass acoustical fill. Provide net sound reduction indicated. Obtain values on a test unit not less than 24 by 24 inches outside dimensions made by a certified nationally recognized independent acoustical laboratory. Provide air flow capacity as indicated or required. Provide pressure drop through the attenuator that does not exceed the value indicated, or that is not in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Acoustically test attenuators with metal duct inlet and outlet sections while under the rated air flow conditions. Include with the noise reduction data the effects of flanking paths and vibration transmission. Construct sound attenuators to be airtight when operating at the internal static pressure indicated or specified for the duct system, but in no case less than 2 inch water gauge.

2.9.9 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 diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. 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.

2.9.9.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Construction for the interchangeable use as cooled or heated air supply diffusers or return air units. 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.

2.9.9.2 Registers and Grilles

Provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. 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. Achieve four-way directional control by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.9.10 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.

2.9.11 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.

2.10 AIR SYSTEMS EQUIPMENT

2.10.1 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 120 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.

2.10.1.1 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 totally enclosed enclosures.

2.10.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. 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. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11.

2.10.1.3 Air-Curtain Fans

Provide fans that conform to AMCA 220 with AMCA seal. Furnish air curtains with a weatherproof housing constructed of high impact plastic or minimum 18 gauge rigid welded steel. Provide backward curved, non-overloading, centrifugal type fan wheels, accurately balanced statically and dynamically. Provide motors with totally enclosed fan cooled enclosures. Provide remote manual type motor starters with weather-resistant enclosure actuated when the doorway served is open. Provide air curtains that attain the air velocities specified within 2 seconds following activation. Provide bird screens at air intake and discharge openings. Provide air curtain unit or a multiple unit installation that is at least as wide as the opening to be protected. Provide the air discharge openings to permit outward adjustment of the discharge air. Place installation and adjust according to the manufacturer's written recommendation. Furnish directional controls on air curtains for service windows for easy clean or convenient removal. Design air curtains to prevent the adjustment of the air velocities specified. Make the interior surfaces of the air curtain units accessible for cleaning. Provide certified test data indicating that the fan can provide the air velocities required when fan is mounted as indicated. Provide air curtains designed as fly fans unless otherwise indicated.

2.10.2 Coils

Provide fin-and-tube type coils constructed of seamless copper tubes and aluminum fins mechanically bonded or soldered to the tubes. Provide copper tube wall thickness that is a minimum of 0.024 inches.. Provide aluminum fins that are 0.0055 inch minimum thickness. Provide casing and tube support sheets that are not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, provide multiple tube supports to prevent tube sag. Mount coils for counterflow service. Rate and certify coils to meet the requirements of AHRI 410.

2.10.2.1 Direct-Expansion Coils

Provide suitable direct-expansion coils for the refrigerant involved. Provide refrigerant piping that conforms to ASTM B280 and clean, dehydrate and seal. Provide seamless copper tubing suction headers or seamless or resistance welded steel tube suction headers with copper connections. Provide supply headers that consist of a distributor which distributes the refrigerant through seamless copper tubing equally to all circuits in the coil. Provide circuited tubes to ensure minimum pressure drop and maximum heat transfer. Provide circuiting that permits refrigerant flow from inlet to suction outlet without causing oil slugging or restricting refrigerant flow in coil. Provide field installed coils which are completely dehydrated and sealed at the factory upon completion of pressure tests. Pressure test coils in accordance with UL 1995.

2.10.2.2 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.

2.10.3 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.

2.10.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size indicated 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.

2.10.3.2 Holding Frames

Fabricate frames from not lighter than 16 gauge sheet steel with rust-inhibitor coating. Equip each holding frame with suitable filter holding devices. Provide gasketed holding frame seats. Make all joints airtight.

2.10.3.3 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Provide gauges that are at least 3-7/8 inches in diameter, with white dials with black figures, and graduations, with a minimum range of 1 inch of water beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum tubing, and all hardware and accessories for gauge mounting.

2.11 AIR HANDLING UNITS

2.11.1 Factory-Fabricated Make-Up Air Units

Provide single-zone draw-through type units as indicated. Units must include fans, coils, airtight insulated casing, prefilters, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, vibration-isolators, and appurtenances required for specified operation. Provide vibration isolators as indicated. Physical dimensions of each air handling unit must be suitable to fit space allotted to the unit with the capacity indicated. Provide air handling unit that is rated in accordance with AHRI 430 and AHRI certified for cooling.

2.11.1.1 Casings

Provide the following:

a. Casing sections 2 inch double wall type, constructed of a minimum 18 gauge galvanized steel, or 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Design and construct casing with an integral insulated structural galvanized steel frame such that exterior panels are non-load bearing.

b. Individually removable exterior panels with standard tools. Removal must not affect the structural integrity of the unit. Furnish casings with access sections, according to paragraph AIR HANDLING UNITS, inspection doors, and access doors, all capable of opening a minimum of 90 degrees, as indicated.

c. Insulated, fully gasketed, double-wall type inspection and access doors, of a minimum 18 gauge outer and 20 gauge inner panels made of either galvanized steel or corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Provide rigid doors with heavy duty hinges and latches. Inspection doors must be a minimum 12 inches wide by 12 inches high. Access doors must be a minimum 24 inches wide, the full height of the unit casing or a minimum of 6 foot, whichever is less.

d. Double-wall insulated type drain pan (thickness equal to exterior casing) constructed of 16 gauge corrosion resisting sheet steel conforming to ASTM A167, Type 304, conforming to ASHRAE 62.1. Construct drain pans water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils must not flow across the face of lower coils. Provide intermediate drain pans or condensate collection channels and downspouts, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Construct drain pan to allow for easy visual inspection, including underneath the coil without removal of the coil and to allow complete and easy physical cleaning of the pan underneath the coil without removal of the coil. Provide coils that are individually removable from the casing.

e. Casing insulation that conforms to NFPA 90A. Insulate single-wall casing sections handling conditioned air with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Insulate double-wall casing sections handling conditioned air with not less than 2 inches of the same insulation specified for single-wall casings. Foil-faced insulation is not an acceptable substitute for use with double wall casing. Seal double wall insulation completely by inner and outer panels.

f. Factory applied fibrous glass insulation that conforms to ASTM C1071, except that the minimum thickness and density requirements do not apply, and that meets the requirements of NFPA 90A. Make air handling unit casing insulation uniform over the entire casing. Foil-faced insulation is not an acceptable substitute for use on double-wall access doors and inspections doors.

g. A latched and hinged inspection door, in the fan and coil sections.

2.11.1.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.11.1.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.11.1.4 Fans

Provide the following:

a. Fans that are double-inlet, centrifugal type with each fan in a separate scroll. Dynamically balance fans and shafts prior to installation into air handling unit, then after it has been installed in the air handling unit, statically and dynamically balance the entire fan assembly. Mount fans on steel shafts, accurately ground and finished.

b. Fan bearings that are sealed against dust and dirt and are precision self-aligning ball or roller type, with L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide bearings that are permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Support bearings by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Do not fasten bearings directly to the unit sheet metal casing. Furnish fans and scrolls with coating indicated.

2.11.1.5 Access Sections and Filter/Mixing Boxes

Provide access sections where indicated and furnish with access doors as shown. Construct access sections and filter/mixing boxes in a manner identical to the remainder of the unit casing and equip with access doors. Design mixing boxes to minimize air stratification and to promote thorough mixing of the air streams.

2.12 TERMINAL UNITS

2.12.1 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 or dual duct system applications. Provide actuators and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. For each VAV terminal unit, provide a temperature sensor in the unit discharge ductwork.

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.

2.12.1.1 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 0.25 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.

2.12.1.2 Reheat Units

2.12.1.2.1 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.

2.13 ENERGY RECOVERY DEVICES

2.13.1 Plate Heat Exchanger

Provide energy recovery ventilator unit that is factory-fabricated for indoor installation, consisting of a flat plate cross-flow heat exchanger, cooling coil, supply air fan and motor and exhaust air fan and motor. The casing must be 20 gauge G90, galvanized steel, double wall construction with one inch insulation. Provide fibrous desiccant cross-flow type heat exchanger core capable of easy removal from the unit.

2.14 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 125 hours for units to be installed indoors and 500 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.

## 2.15 SUPPLEMENTAL COMPONENTS/SERVICES

### 2.15.1 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 23 00 REFRIGERANT PIPING.

### 2.15.2 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.

### 2.15.3 Backflow Preventers

The requirements for backflow preventers are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

### 2.15.4 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

### 2.15.5 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 a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. 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, 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 Finish Painting

The requirements for finish painting of items only primed at the factory, and surfaces not specifically noted otherwise, are specified in Section 09 90 00 PAINTS AND COATINGS.

## 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 DUCTWORK LEAK TEST

Perform ductwork leak test for the entire air distribution and exhaust system, including fans, coils, filters, etc. Complete ductwork leak test with satisfactory results prior to applying insulation to ductwork exterior or concealing ductwork.

## 3.10 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.

## 3.11 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.

## 3.12 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.

## 3.13 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.

## 3.14 OPERATION AND MAINTENANCE

### 3.14.1 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

### 3.14.2 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 16 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.

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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 801 | (2001; R 2008) Industrial Process/Power Generation Fans: Specification Guidelines |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME B1.20.1 | (2013; R 2018) Pipe Threads, General Purpose (Inch) |
| ASME B16.3 | (2021) Malleable Iron Threaded Fittings, Classes 150 and 300 |
| ASME B16.4 | (2021) Gray Iron Threaded Fittings; Classes 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 B16.15 | (2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250 |
| ASME B16.26 | (2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes |
| ASME B16.34 | (2021) Valves - Flanged, Threaded and Welding End |
| ASME B16.39 | (2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300 |
| 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 | (2021) Control and Safety Devices for Automatically Fired Boilers |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C606 | (2015) Grooved and Shouldered Joints |

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 A53/A53M | (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A105/A105M | (2021) Standard Specification for Carbon Steel Forgings for Piping Applications |
| ASTM A167 | (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A193/A193M | (2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications |
| ASTM A234/A234M | (2019) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service |
| 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 A653/A653M | (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM B32 | (2020) Standard Specification for Solder Metal |
| ASTM B62 | (2017) Standard Specification for Composition Bronze or Ounce Metal Castings |
| ASTM B88 | (2020) Standard Specification for Seamless Copper Water Tube |
| ASTM B813 | (2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube |
| ASTM D596 | (2001; R 2018) Standard Guide for Reporting Results of Analysis of Water |
| ASTM D1784 | (2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds |

COPPER DEVELOPMENT ASSOCIATION (CDA)

| | |
|---|---|
| CDA A4015 | (2016; 14/17) Copper Tube Handbook |

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

| | |
|---|---|
| EJMA Stds | (2015) (10th Ed) EJMA Standards |

HYDRONICS INSTITUTE DIVISION OF AHRI (HYI)

| | |
|---|---|
| HYI-005 | (2008) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial) |

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-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 |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2020) Enclosures for Electrical Equipment (1000 Volts Maximum) |
| NEMA MG 1 | (2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31 |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 54 | (2021) National Fuel Gas Code |

U.S. DEPARTMENT OF ENERGY (DOE)

| | |
|---|---|
| Energy Star | (1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 1738 | (2020; Reprint Aug 2021) UL Standard for SafetyVenting Systems for Gas-Burning Appliances, Categories II, III and IV |
| UL FLAMMABLE & COMBUSTIBLE | (2012) Flammable and Combustible Liquids and Gases Equipment 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

Detail Drawings; G-AE

SD-03 Product Data

Materials and Equipment; G-AE

Spare Parts

Boiler Water Treatment

Unit Heaters; G-AE

Welding

Qualifications

Field Instructions

Tests

SD-06 Test Reports

Heating System Tests

Fuel System Tests

Water Treatment Testing

SD-07 Certificates

Bolts

SD-10 Operation and Maintenance Data

Operation and Maintenance Instructions; G-RO

SD-11 Closeout Submittals

Indoor Air Quality During Construction

## 1.3 QUALITY ASSURANCE

Submit a copy of qualified welding procedures and a list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations. Boilers and piping shall be welded and brazed 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. Notify the Contracting Officer 24 hours in advance of tests, and the tests shall be performed at the work site if practical. The welder or welding operator shall apply the personally assigned symbol near each weld made as a permanent record. Structural members shall be welded in accordance with Section 05 05 23.16 STRUCTURAL WELDING.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

## 1.5 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and no later than 2 months prior to the date of beneficial occupancy. Submit Detail Drawings consisting of equipment layout including installation details and electrical connection diagrams; combustion and safety control diagrams;

ductwork layout showing the location of supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of guides and anchors, the load imposed on each support or anchor (not required for radiant floor tubing), and typical support details. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function as a unit and to show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

## PART 2 PRODUCTS

### 2.1 MATERIALS AND EQUIPMENT

#### 2.1.1 Standard Products

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. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Submit manufacturer's catalog data included with the detail drawings for the following:

a. Data showing model, size, options, etc., that are intended for consideration. Data submitted shall be adequate to demonstrate compliance with contract requirements. Data shall include manufacturer's written installation instructions and manufacturer's recommendations for operation and maintenance clearances for the following:

    (1) Boilers
    (2) Unit Heaters
    (3) Pumps
    (4) Fittings and Accessories

#### 2.1.2 Asbestos Prohibition

Asbestos and asbestos-containing products will not be allowed.

#### 2.1.3 Nameplates

Secure a plate to each major component of equipment containing the manufacturer's name, address, type or style, model or serial number, and catalog number. Also, display an Energy Star label as applicable. Each pressure vessel shall have an approved ASME stamp.

#### 2.1.4 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified.

## 2.2 BOILERS

Each boiler shall have the output capacity in British thermal units per hour (Btuh) as indicated when fired with the specified fuels. The boiler shall be furnished complete with the gas burning equipment, boiler fittings and trim, automatic controls, forced draft fan, electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at the manufacturer's plant. Boiler auxiliaries including fans, motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with ASME BPVC SEC IV. Each boiler shall be of the cast iron condensing type and designed for water service as specified herein. The boiler capacity shall be based on the ratings shown in HYI-005 or as certified by the American Boiler Manufacturers Association, or American Gas Association.

### 2.2.1 Cast Iron Boiler

Boiler shall be of the rectangular, sectional type, self-contained, packaged type, complete with accessories, mounted on a structural steel base. Cast iron sections shall be free of leaks under all operating conditions. Access shall be provided to permit cleaning of internal tube surfaces.

### 2.2.2 Condensing Boiler

Each boiler shall be a self-contained packaged type, complete with accessories, mounted on a structural steel base or a steel base which is integral to the boiler shell. Each boiler shall conform to the commercial design used by the manufacturer and shall permit free thermal expansion without placing undue stress on any part of the boiler. Each boiler which experiences the formation of condensate within the flue gas shall be specifically designed for condensing application. Each boiler shall withstand the corrosive effects of condensate for each part which may be in contact with the condensate at all possible operating conditions. Each boiler shall be provided with a separate air intake, exhaust, and condensate drain. Each boiler shall be designed to withstand the water temperature differentials anticipated at the required operating conditions without experiencing any damage due to thermal shock.

### 2.2.3 Modular Configuration

Modular boilers shall be of the cast iron, condensing type. Modular boilers shall have the capability of independent operation. Upon failure of any module, the remaining modules shall be capable of operating at their designed capacity. The size of the individual modules shall be as indicated.

## 2.3 FUEL BURNING EQUIPMENT

### 2.3.1 Draft Fans

Fans conforming to AMCA 801 forced-draft shall be furnished as an integral part of boiler design. Fans shall be centrifugal with backward-curved

blades. Each fan shall be sized for output volume and static pressure rating sufficient for pressure losses, excess air requirements at the burner, leakages, temperature, and elevation corrections for worst ambient conditions, all at full combustion to meet net-rated output at normal firing conditions, plus an overall excess air volume of 10 percent against a 20 percent static overpressure. Noise levels for fans shall not exceed 85 decibels in any octave band at a 3 foot station. Forced draft fan bearings shall be air cooled.

#### 2.3.1.1 Draft Fan Drives

Fans shall be driven by electric motors. Electric motor shall be totally enclosed fan cooled.

### 2.3.2 Draft Damper

Boilers shall be provided with automatic dampers, draft hoods, or barometric dampers as recommended by the boiler manufacturer to maintain proper draft in the boiler. Draft damper shall be provided in a convenient and accessible location in the flue gas outlet from the boiler. Automatic damper shall be arranged for automatic operation by means of a damper regulator.

### 2.3.3 Ductwork

Air ducts connecting the forced-draft fan units with the plenum chamber shall be designed to convey air with a minimum of pressure loss due to friction. Ductwork shall be galvanized sheet metal conforming to ASTM A653/A653M. Ducts shall be straight and smooth on the inside with laps made in direction of air flow. Ducts shall have cross-break with enough center height to assure rigidity in the duct section, shall be angle iron braced, and shall be completely free of vibration. Access and inspection doors shall be provided as indicated and required, with a minimum of one in each section between dampers or items of equipment. Ducts shall be constructed with long radius elbows having a centerline radius 1-1/2 times the duct width, or where the space does not permit the use of long radius elbows, short radius or square elbows with factory-fabricated turning vanes may be used. Duct joints shall be substantially airtight and shall have adequate strength for the service, with 1-1/2 x 1-1/2 x 1/8 inch angles used where required for strength or rigidity. Duct wall thickness shall be 16 gauge (0.0598 inch) for ducts 60 inches or less and 12 gauge (0.1046 inch) for ducts larger than 60 inches in maximum dimension. Additional ductwork shall be in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

## 2.4 COMBUSTION CONTROL EQUIPMENT

Combustion control equipment shall be provided as a system by a single manufacturer. Field installed automatic combustion control system shall be installed in accordance with the manufacturer's recommendations and under the direct supervision of a representative of the control manufacturer. The boiler water temperature shall be controlled by a water temperature controller. The equipment shall operate electronically. On multiple boiler installations, each boiler unit shall have a completely independent system of controls responding to the load and to a plant master controller. If recording instruments are provided, a 1 year supply of ink and 400 blank charts for each recorder shall be furnished.

2.4.1 Electrical controls

Electrical control devices shall be rated at 120 volts and shall be connected as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.4.2 Water Temperature Controller

The controller shall be of sturdy construction and shall be protected against dust and dampness. The thermostatic element shall be inserted in a separable socket installed in the upper part of the boiler near the water outlet. Modulating controllers shall control the fuel burning equipment to maintain set boiler water temperature within 2 percent. Controller shall be furnished with necessary equipment to automatically adjust the setting to suit the outside weather conditions. The outside air reset controller shall be operated in such a manner that the operating temperatures required by the boiler manufacturer are not compromised.

2.4.3 Boiler Combustion Controls and Positioners

a. Gas boiler units shall be provided with modulating combustion controls with gas pilot or spark ignition. Modulating controls shall be provided with a means for manually controlling the firing rate.

b. Modulating control function shall be accomplished using positioning type controls. Air flow ratio and fuel control valve shall be controlled by relative positions of operative levers on a jackshaft responding to a water temperature controller. Positioning type combustion control equipment shall include draft controls with synchronized fuel feed and combustion air supply controls, while and shall maintain the proper air/fuel ratio. The desired furnace draft shall be maintained within 0.01 inch of water column.

2.4.4 Combustion Safety Controls and Equipment

Combustion safety controls and equipment shall be UL listed, microprocessor-based distributed process controller. The system shall include mounting hardware, wiring and cables, and associated equipment. The controller shall be mounted completely wired, programmed, debugged, and tested to perform all of its functions. The controller shall process the signals for complete control and monitoring of the boiler. This shall include maintaining boiler status, starting and stopping all control functions, sequencing control functions and signaling alarm conditions. The program shall be documented and include cross references in description of coils and contacts. Microprocessor shall be able to perform self diagnostics and contain a message center to provide operator with status and failure mode information. Controllers for each boiler shall be mounted on a separate, free standing panel adjacent to the boiler or for packaged boilers on the boiler supporting structure. Control systems and safety devices for automatically fired boilers shall conform to ASME CSD-1. Electrical combustion and safety controls shall be rated at 120 volts, single phase, 60 Hz and shall be connected as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. A 4 inch diameter alarm bell shall be provided and shall be located where indicated or directed. The alarm bell shall ring when the boiler is shut down by any safety control or interlock. Indicating lights shall be provided on the control panel. A red light shall indicate flame failure, and a green light shall indicate that the main fuel valve is open. The following shutdown conditions shall require a manual reset before the boiler can automatically recycle:

a. Flame failure.

b. Failure to establish pilot flame.

c. Failure to establish main flame.

d. Low-water cutoff.

e. High temperature cutoff.

2.4.4.1 Low-water Cutoff

Low water cutoff shall be float actuated switch or electrically actuated probe type low-water cutoff. Float chamber shall be provided with a blow-down connection. Cutoff shall cause a safety shutdown and sound an alarm when the boiler water level drops below a safe minimum level. A safety shutdown due to low water shall require manual reset before operation can be resumed and shall prevent recycling of the burner. The cutoff shall be in strict accordance to ASME CSD-1.

2.4.4.1.1 Feedwater Regulator with Low-Water Cutoff

Regulator shall be an approved design sized for the application. A regulator shall be provided for each boiler. The feeder shall be so arranged that water will be fed to the boiler automatically when the water level in the boiler drops below a preset point and will actuate the alarm bell when the water level reaches the low danger point. The boiler feeder shall be arranged so that the burner and forced-draft fan will stop whenever the water level drops below a preset danger point. The boiler feeder shall be constructed so that the feedwater valve and seat are isolated from the float chamber to prevent overheating of the feed water and precipitation of scale on either the valve or seat. Each float mechanism, valve, and seat shall be constructed of an approved, durable, corrosion-resistant steel alloy. Valve seats shall be removable and renewable. The regulator shall be equipped with a large, self-cleaning strainer. The drain valve on the regulator shall be the gate or other straight-through type.

2.4.4.2 Water Flow Interlock

Hot water boiler limit controls shall be provided to include protection for low boiler water flow and high boiler water temperature. The limit controls shall be interlocked with the combustion control system to effect boiler alarm and shutdown. The controls shall not allow boiler startup unless hot water flow is proven.

2.5 COLD WATER CONNECTIONS

Connections shall be provided which includes consecutively in line a strainer, reduced pressure principle backflow preventers, and water pressure regulator in that order in the direction of the flow. The reduced pressure principle backflow preventers shall be provided as indicated and in compliance with Section 22 00 00 PLUMBING, GENERAL PURPOSE. Cold water fill connections shall be made to the water supply system as indicated. Necessary pipe, fittings, and valves required for water connections between the boiler and cold water main shall be provided as shown. The pressure regulating valve shall be of a type that will not stick or allow pressure to build up on the low side. The valve shall be

set to maintain a terminal pressure of approximately 5 psi in excess of the static head on the system and shall operate within a 2 psi tolerance regardless of cold water supply piping pressure and without objectionable noise under any condition of operation.

## 2.6 UNIT HEATERS

Heaters shall be as specified below, and shall have a heating capacity not in excess of 125 percent of the capacity indicated.

### 2.6.1 Propeller Fan Heaters

Heaters shall be designed for suspension and arranged for horizontal discharge of air as indicated. Casings shall be not less than 20 gauge black steel and finished with lacquer or enamel. Suitable stationary deflectors shall be provided to assure proper air and heat penetration capacity at floor level based on established design temperature. Suspension from heating pipes will not be permitted. Horizontal discharge type unit heaters shall have discharge or face velocities not in excess of the following:

| Unit Capacity, cfm | Face Velocity, fpm |
|---|---|
| Up to 1000 | 800 |
| 1,001 to 3,000 | 900 |
| 3001 and over | 1,000 |

### 2.6.2 Motors

Motors shall be provided with NEMA 250 general purpose enclosure. Motors and motor controls shall otherwise be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

### 2.6.3 Motor Switches

Motors shall be provided with manual selection switches with "Off," and "Automatic" positions and shall be equipped with thermal overload protection.

### 2.6.4 Controls

Controls shall be provided as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

## 2.7 HEATING AND VENTILATING UNITS

Heating and ventilating units and associated equipment shall be in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

## 2.8 AIR HANDLING UNITS

Air handling units and associated equipment shall be in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

## 2.9 FITTINGS AND ACCESSORIES

Boiler fittings and accessories shall be installed with each boiler in accordance with ASME BPVC SEC IV, unless otherwise specified.

### 2.9.1 Direct Vents

Direct venting shall be used for condensing type boilers. Both the air intake and exhaust vents shall be sized and located as indicated on the drawings and as recommended by the boiler manufacturer. A separate combustion air intake vent and exhaust vent shall be provided for each boiler.

#### 2.9.1.1 Combustion Air Intake Vent

The combustion air intake piping shall be constructed of Schedule 40 PVC in accordance with ASTM D1784. The vent shall be suitable for the temperature at the boiler combustion air intake connection point. Each intake shall be provided complete with bird screen.

#### 2.9.1.2 Exhaust Vent

The exhaust vent piping shall be constructed of stainless steel conforming to UL 1738 and the boiler manufacturer's recommendations. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. The exhaust vent shall be suitable for the maximum anticipated boiler exhaust temperature and shall withstand the corrosive effects of the condensate. A 0.3125 inch diameter hole shall be provided in the stack not greater than 6 inches from the boiler flue outlet for sampling of the exit gases. A method shall be provided to seal the hole to prevent exhaust gases from entering the boiler room when samples are not being taken. Each exhaust stack shall be provided complete with bird screen.

### 2.9.2 Expansion Tank

The hot water pressurization system shall include a diaphragm-type 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. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. The sizes shall be as indicated. The expansion tank shall be welded steel, constructed, tested, and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psi and precharged to the minimum operating pressure. The tank's air chamber shall be fitted with an air charging valve and pressure gauge. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The tank shall have lifting rings and a drain connection. All components shall be suitable for a maximum operating temperature of 250 degrees F.

### 2.9.3 Air Separator

External air separation tank shall be steel, constructed, tested and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psi. The capacity of the air separation tank indicated is minimum.

2.9.4 Steel Pipe and Fittings

2.9.4.1 Steel Pipe

Steel pipe shall be ASTM A53/A53M, Type E or S, Grade A or B, black steel, standard weight.

2.9.4.2 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.9.4.3 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. 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. Flanges for high temperature water systems shall be serrated or raised-face type. 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. Submit written certification by the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

2.9.4.4 Welded Fittings

Welded fittings shall conform to ASTM A234/A234M with WPA marking. Buttwelded fittings shall conform to ASME B16.9, and socket-welded fittings shall conform to ASME B16.11.

2.9.4.5 Cast-Iron Fittings

Fittings shall be ASME B16.4, Class 125, type required to match connecting piping.

2.9.4.6 Malleable-Iron Fittings

Fittings shall be ASME B16.3, type as required to match connecting piping.

2.9.4.7 Unions

Unions shall be ASME B16.39, Class 150.

2.9.4.8 Threads

Pipe threads shall conform to ASME B1.20.1.

2.9.5 Copper Tubing and Fittings

2.9.5.1 Copper Tubing

Tubing shall be ASTM B88, Type K or L. Adapters for copper tubing shall be brass or bronze for brazed fittings.

2.9.5.2 Flared Fittings

Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62.

2.9.5.3 Adapters

Adapters 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.

2.9.5.4 Threaded Fittings

Cast bronze threaded fittings shall conform to ASME B16.15.

2.9.5.5 Brazing Material

Brazing material shall conform to AWS A5.8/A5.8M.

2.9.5.6 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. Silver brazing materials shall be in accordance with AWS A5.8/A5.8M.

2.9.5.7 Solder Material

Solder metal shall conform to ASTM B32 95-5 tin-antimony.

2.9.5.8 Solder Flux

Flux shall be either liquid or paste form, non-corrosive and conform to ASTM B813.

2.9.6 Dielectric Waterways and Flanges

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 include dielectric unions to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.9.7 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psi or 150 psi service. Connectors shall be installed where indicated. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, and temperature medium. The flexible section shall be suitable for service intended and may have threaded, welded, soldered, flanged, or socket ends. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners,

compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.9.8 Pipe Supports

Pipe supports shall conform to MSS SP-58.

2.9.9 Pipe Expansion

2.9.9.1 Expansion Loops

Expansion loops and offsets shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1. The loops and offsets shall be cold-sprung and installed where indicated. Pipe guides and anchors shall be provided as indicated.

2.9.9.2 Expansion Joints

Expansion joints shall provide for either single or double slip of the connected pipes, as required or indicated, and for not less than the transverse indicated. The joints shall be designed for a hot water working pressure not less than 125 psig and shall be in accordance with applicable requirements of EJMA Stds and ASME B31.1. End connection shall be flanged. Anchor bases or support bases shall be provided as indicated or required. Sliding surfaces and water wetted surfaces shall be chromium plated or fabricated of corrosion resistant steel. Initial setting shall be made in accordance with the manufacturer's recommendations to compensate for an ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer, but in any case shall not be more than 5 feet from expansion joint, except in lines 4 inches or smaller guides shall be installed not more than 2 feet from the joint. Service outlets shall be provided where indicated.

2.9.9.2.1 Bellows-Type joint

Bellows-type joints shall be flexible, guided expansion joints. The expansion element shall be stabilized corrosion resistant steel. Bellows-type expansion joints shall conform to the applicable requirements of EJMA Stds and ASME B31.1 with internal lines. Guiding of piping on both sides of expansion joint shall be in accordance with the published recommendations of the manufacturer of the expansion joint. The joints shall be designed for the working temperature and pressure suitable for the application but shall not be less than 150 psig.

2.9.9.2.2 Flexible Ball Joint

Flexible ball joints shall be constructed of alloys as appropriate for the service intended. The joints shall be threaded, grooved, flanged, or welded end as required and shall be capable of absorbing the normal operating axial, lateral, or angular movements or combination thereof. Balls and sockets shall be polished, chromium-plated when materials are not of corrosion-resistant steel. The ball type joint shall be designed and constructed in accordance with ASME B31.1 and EJMA Stds. Flanges shall conform to the diameter and drilling of ASME B16.5. Molded gaskets shall be suitable for the service intended.

2.9.9.2.3 Slip Type Expansion Joint

Slip type expansion joints shall be EJMA Stds and ASME B31.1, Class 1 or 2. Type II joints shall be suitable for repacking under full line pressure.

2.9.10 Valves

Valves shall be Class 125 and shall be suitable for the application. Grooved ends in accordance with AWWA C606 may be used for water service only. Valves in nonboiler external piping shall meet the material, fabrication and operating requirements of ASME B31.1. The connection type of all valves shall match the same type of connection required for the piping on which installed.

2.9.10.1 Gate Valves

Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80 bronze rising stem, threaded, solder, or flanged ends. Gate valves 3 inches and larger shall conform to MSS SP-70 cast iron bronze trim, outside screw and yoke, flanged, or threaded ends.

2.9.10.2 Globe Valves

Globe valves 2-1/2 inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 3 inches and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

2.9.10.3 Check Valves

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71, cast iron, bronze trim, flanged, or threaded ends.

2.9.10.4 Angle Valves

Angle valves 2-1/2 inches and smaller shall conform to MSS SP-80 bronze, threaded, soldered, or flanged ends. Angle valves 3 inches and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

2.9.10.5 Ball Valves

Ball valves 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110, ductile iron or bronze, threaded, soldered, or flanged ends.

2.9.10.6 Plug Valves

Plug valves 2 inch and larger shall conform to MSS SP-78. Plug valves smaller than 2 inch shall conform to ASME B16.34.

2.9.10.7 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register the degree of valve opening. Valves shall be calibrated so that flow rate can be determined when valve opening in degrees and pressure differential across valve is known. Each

balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 250 degrees F temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves, and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.9.10.8 Automatic Flow Control Valves

In lieu of the specified balancing valves, automatic flow control valves may be provided to maintain constant flow and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 125 psi or 150 percent of the system operating pressure, whichever is greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be increased. Valves shall be suitable for 250 degrees F temperature service. Valve materials shall be same as specified for the heating system check, globe, angle, and gate valves. Valve operator shall be the electric motor type. Valve operator shall be capable of positive shutoff against the system pump head. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter shall be provided with accessory kit as recommended for the project by the automatic valve manufacturer.

2.9.10.9 Butterfly Valves

Butterfly valves shall be 2-flange type or lug wafer type, and shall be bubbletight at 150 psig. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A167, Type 404 or Type 316, corrosion resisting steel stems, bronze, or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.9.10.10 Drain valves

Drain valves shall be provided at each drain point of blowdown as recommended by the boiler manufacturer. Piping shall conform to ASME BPVC SEC IV and ASTM A53/A53M.

2.9.10.11 Safety Valves

Safety valves shall have steel bodies and shall be equipped with corrosion-resistant trim and valve seats. The valves shall be properly guided and shall be positive closing so that no leakage can occur. Adjustment of the desired back-pressure shall cover the range between 2 and 10 psig. The adjustment shall be made externally, and any shafts extending through the valve body shall be provided with adjustable stuffing boxes having renewable packing. Boiler safety valves of proper size and of the required number, in accordance with ASME BPVC SEC IV, shall be installed so that the discharge will be through piping extended to a location as indicated. Each discharge pipe for hot water service shall be pitched away from the valve seat.

2.9.11 Strainers

Basket and "Y" type strainers shall be the same size as the pipelines in which they are installed. The strainer bodies shall be heavy and durable, fabricated of cast iron, and shall have bottoms drilled and tapped with a gate valve attached for blowdown purposes. Strainers shall be designed for 125 psig service and 250 degrees F. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment screen. The screen shall be made of 22 gauge thick corrosion-resistant steel with small perforations numbering not less than 400/square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.9.12 Pressure Gauges

Gauges shall conform to ASME B40.100 and shall be provided with throttling type needle valve or a pulsation dampener and shutoff valve. Minimum dial size shall be 3-1/2 inches. A pressure gauge shall be provided for each boiler in a visible location on the boiler. Pressure gauges shall be provided with readings in psi. Pressure gauges shall have an indicating pressure range that is related to the operating pressure of the fluid in accordance with the following table:

| Operating Pressure (psi) | Pressure Range (psi) |
|---|---|
| 76-150 | 0-200 |
| 16-75 | 0-100 |
| 2-15 | 0-30 (retard) |

2.9.13 Thermometers

Thermometers shall be provided with wells and separable corrosion-resistant steel sockets. Mercury shall not be used in thermometers. Thermometers for inlet water and outlet water for each hot water boiler shall be provided in a visible location on the boiler. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a minimum 9 inch scale. The operating range of the thermometers shall be 32-212 degrees F. The thermometers shall be provided with readings in degrees F.

### 2.9.14 Air Vents

#### 2.9.14.1 Manual Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for the pressure rating of the piping system and furnished with threaded plugs or caps.

#### 2.9.14.2 Automatic Air Vents

Automatic air vents shall be 3/4 inch quick-venting float and vacuum air valves. Each air vent valve shall have a large port permitting the expulsion of the air without developing excessive back pressure, a noncollapsible metal float which will close the valve and prevent the loss of water from the system, an air seal that will effectively close and prevent the re-entry of air into the system when subatmospheric pressures prevail therein, and a thermostatic member that will close the port against the passage of steam from the system. The name of the manufacturer shall be clearly stamped on the outside of each valve. The air vent valve shall be suitable for the pressure rating of the piping system.

## 2.10 ELECTRICAL EQUIPMENT

Electric motor-driven equipment shall be provided complete with motors, motor starters, and necessary control devices. Electrical equipment, motor control devices, motor efficiencies and wiring shall be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Motors which are not an integral part of a packaged boiler and which are integral in size shall be the premium efficiency type in accordance with NEMA MG 1. Motors which are an integral part of the packaged boiler shall be the highest efficiency available by the manufacturer of the packaged boiler. Motor starters shall be provided complete with properly sized thermal overload protections and other appurtenances necessary for the motor control specified. Starters shall be furnished in general purpose enclosures. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices but not shown shall be provided.

### 2.10.1 Motor Ratings

Motors shall be suitable for the voltage and frequency provided. Motors 1/2 hp and larger shall be three-phase, unless otherwise indicated. Motors shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating on the motor.

### 2.10.2 Motor Controls

Motor controllers shall be provided complete with properly sized thermal overload protection. Manual or automatic control and protective or signal devices required for the operation specified and any wiring required to such devices shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Solid state variable speed controllers shall be utilized for fractional through 10 hp ratings. Adjustable frequency drives shall be used for larger motors.

## 2.11 INSULATION

Shop and field-applied insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

## 2.12 TOOLS

Special tools shall be furnished. Special tools shall include uncommon tools necessary for the operation and maintenance of boilers, burners, pumps, fans, controls, meters, special piping systems, and other equipment. Small hand tools shall be furnished within a suitable cabinet, mounted where directed.

### 2.12.1 Wrenches

Wrenches shall be provided as required for specialty fittings such as manholes, handholes, and cleanouts. One set of extra gaskets shall be provided for all manholes and handholes, for pump barrels, and other similar items of equipment. Gaskets shall be packaged and properly identified.

## 2.13 BOILER WATER TREATMENT

### 2.13.1 Water Meter

The water meter shall be provided with an electric contacting register and remote accumulative counter. The meter shall be installed within the makeup water line, as indicated.

### 2.13.2 Chemical Shot Feeder

A shot feeder shall be provided as indicated. Size and capacity of feeder shall be based upon local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

### 2.13.3 Chemical Piping

The piping and fittings shall be constructed of stainless steel.

### 2.13.4 Test Kits

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided.

### 2.13.5 Glycol Feed System

Design the Glycol feed system to automatically maintain the desired glycol content of the closed water recirculation system(s). Each system shall consist of the following components:

#### 2.13.5.1 Supply Tank and Stand

Include a 50 gallon cross lined polyethylene tank and steel support stand. The tank shall have a cover and bottom outlet fitting for pump suction. Equip the tank stand with a pump mounting platform and support for the control panel and level switch.

2.13.5.2 Glycol Pump

Rotary gear type of bronze construction with a capacity of 1.8 gpm at 40 psi. The pump shall have a 1/3 horsepower, 1/115V/60hz motor and internal pressure relief. Provide the pump with a discharge check valve and shutoff valve.

2.13.5.3 Pressure Switch

The pressure switch shall be adjustable over the range of 3 - 15 psi with a 6 psi differential and have contacts rated for 115V.

2.13.5.4 Level Switch

Equipped with N/O and N/C contacts to activate upon sensing a low level condition.

2.13.5.5 Control Panel

The control panel shall be installed in a NEMA 1 enclosure with terminal strip and shall include a red low level alarm light, low level alarm bell and silence button, full voltage motor starter for the glycol pump, and a Hand-Off-Auto selector switch.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work or ordering any materials.

3.2 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

Boiler and auxiliary equipment shall be installed in accordance with manufacturer's written instructions. Proper provision shall be made for expansion and contraction between boiler foundation and floor. This joint shall be packed with suitable nonasbestos rope and filled with suitable compound that will not become soft at a temperature of 100 degrees F. Boilers and firing equipment shall be supported from the foundations by structural steel completely independent of all brickwork. Boiler supports shall permit free expansion and contraction of each portion of the boiler without placing undue stress on any part of the boiler or setting. Boiler breeching shall be as indicated with full provision for expansion and contraction between all interconnected components.

3.3 PIPING INSTALLATION

Unless otherwise specified, nonboiler external pipe and fittings shall conform to the requirements of ASME B31.1. Pipe installed shall be cut accurately to suit field conditions, shall be installed without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Pipes shall be free of burrs, oil, grease and other foreign material and shall be installed to permit free expansion and contraction without damaging the building structure, pipe, pipe joints, or pipe supports. Changes 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 centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be carried through the roof as directed and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 1 inch in 40 feet. Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unless otherwise specified or shown, final connections to equipment shall be made with malleable-iron unions for steel pipe 2-1/2 inches or less in diameter and with flanges for pipe 3 inches or more in diameter. Unions for copper pipe or tubing shall be brass or bronze. Reducing fittings shall be used for changes in pipe sizes. In horizontal hot water lines, reducing fittings shall be eccentric type to maintain the top of the lines at the same level to prevent air binding.

3.3.1 Hot Water Piping and Fittings

Pipe shall be black steel or copper tubing. Fittings for steel piping shall be black malleable iron or cast iron to suit piping. Fittings adjacent to valves shall suit valve material. Grooved mechanical fittings will not be allowed for water temperatures above 230 degrees F.

3.3.2 Vent Piping and Fittings

Vent piping shall be black steel. Fittings shall be black malleable iron or cast iron to suit piping.

3.3.3 Gauge Piping

Piping shall be copper tubing.

3.3.4 Joints

Joints between sections of steel pipe and between steel pipe and fittings shall be threaded, grooved, flanged or welded as indicated or specified. Except as otherwise specified, fittings 1 inch and smaller shall be threaded; fittings 1-1/4 inches and up to but not including 3 inches shall be either threaded, grooved, or welded; and fittings 3 inches and larger shall be either flanged, grooved, or welded. Pipe and fittings 1-1/4 inches and larger installed in inaccessible conduit or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 2-1/2 inches or smaller in diameter and with flanges for pipe 3 inchesor larger in diameter. Joints between sections of copper tubing or pipe shall be flared, soldered, or brazed.

3.3.4.1 Threaded Joints

Threaded joints shall be made with tapered threads properly cut and shall be made perfectly tight with a stiff mixture of graphite and oil or with polytetrafluoroethylene tape applied to the male threads only and in no case to the fittings.

3.3.4.2 Welded Joints

Welded joints shall be in accordance with paragraph GENERAL REQUIREMENTS unless otherwise specified. 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 connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow characteristics where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inch and no more than 1/8 inch.

3.3.4.3 Flared and Brazed Copper Pipe and Tubing

Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation 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. Brazed joints shall be made in conformance with AWS B2.2/B2.2M and CDA A4015 with flux. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver or a silver brazing filler metal. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided in all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Flared or brazed copper tubing to pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing.

3.3.4.4 Soldered Joints

Soldered joints shall be made with flux and are only acceptable for lines 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015.

3.3.4.5 Copper Tube Extracted Joint

An extruded mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.3.5 Flanges and Unions

Flanges shall be faced true, provided with 1/16 inch thick gaskets, and made square and tight. Where steel flanges mate with cast-iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Dielectric pipe unions shall be provided between

ferrous and nonferrous piping to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

3.3.6 Branch Connections

3.3.6.1 Branch Connections for Hot Water Systems

Branches from the main shall pitch up or down as shown to prevent air entrapment. Connections shall ensure unrestricted circulation, eliminate air pockets, and permit complete drainage of the system. Branches shall pitch with a grade of not less than 1 inch in 10 feet. When indicated, special flow fittings shall be installed on the mains to bypass portions of the water through each radiator. Special flow fittings shall be standard catalog products and shall be installed as recommended by the manufacturer.

3.3.7 Flared, Brazed, and Soldered Copper Pipe and Tubing

Copper tubing shall be flared, brazed, or soldered. Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation 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 for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing. Brazed joints shall be made in conformance with CDA A4015. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver, or a silver brazing filler metal. Soldered joints shall be made with flux and are only acceptable for lines 2 inches or smaller. Soldered joints shall conform to ASME B31.5 and shall be in accordance with CDA A4015.

3.3.8 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.3.9 Supports

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. Threaded rods which are used for support shall not be formed or bent. Supports shall not be attached to the underside of concrete filled floors or concrete roof decks unless approved by the Contracting Officer.

3.3.9.1 Seismic Requirements for Supports and Structural Bracing

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Section 13 48 73 BRACING FOR MISCELLANEOUS EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided in this section. Material used for supports shall be as specified in Section 05 12 00 STRUCTURAL STEEL.

3.3.9.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58, except as modified herein.

3.3.9.2.1 Types 5, 12, and 26

Use of Types 5, 12, and 26 is prohibited.

3.3.9.2.2 Type 3

Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe, if the clamp bottom does not extend through the insulation, and if the top clamp attachment does not contact the insulation during pipe movement.

3.3.9.2.3 Type 18

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.

3.3.9.2.4 Type 19 and 23 C-Clamps

Torque Type 19 and 23 C-clamps in accordance with MSS SP-58 and have both locknuts and retaining devices furnished by the manufacturer. Field fabricated C-clamp bodies or retaining devices are not acceptable.

3.3.9.2.5 Type 20 Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.3.9.2.6 Type 24

Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.3.9.2.7 Horizontal Pipe Supports

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.

3.3.9.2.8 Vertical Pipe Support

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

3.3.9.2.9 Type 35 Guides

Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

a. Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle may be welded to the pipe and freely rested on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rested on a steel slide plate.

b. 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.

3.3.9.2.10 Horizontal Insulated Pipe

Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

3.3.9.2.11 Structural Steel Attachments

Structural steel attachments and brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section 05 12 00 STRUCTURAL STEEL. Pipe hanger loads suspended from steel joist between panel points shall not exceed 50 pounds. Loads exceeding 50 pounds shall be suspended from panel points.

3.3.9.3 Multiple Pipe Runs

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 member shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run. The clips or clamps shall be rigidly attached to the common base member. A clearance of 1/8 inch shall be provided between the pipe insulation and the clip or clamp for piping which may be subjected to thermal expansion.

3.3.10 Anchors

Anchors shall be provided where necessary to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.3.11 Valves

Valves shall be installed where indicated, specified, and required for functioning and servicing of the systems. Valves shall be safely accessible. Swing check valves shall be installed upright in horizontal lines and in vertical lines only when flow is in the upward direction. Gate and globe valves shall be installed with stems horizontal or above. Valves to be brazed shall be disassembled prior to brazing and all packing removed. After brazing, the valves shall be allowed to cool before reassembling.

3.3.12 Pipe Sleeves

Pipe passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. A waterproofing clamping flange shall be installed as indicated where membranes are 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 wall, floor, or roof. Sleeves through walls shall be cut flush with wall surface. Sleeves through floors shall extend above top surface of floor a sufficient distance to allow proper flashing or finishing. Sleeves through roofs shall extend above the top surface of roof at least 6 inches for proper flashing or finishing. Unless otherwise indicated, sleeves shall be sized to provide a minimum clearance of 1/4 inch between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in waterproofing membrane floors, bearing walls, and wet areas shall be galvanized steel pipe or cast-iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be galvanized steel pipe, cast-iron pipe, or galvanized sheet metal with lock-type longitudinal seam. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls shall be sealed as indicated and specified in Section 07 92 00 JOINT SEALANTS. Metal jackets shall be provided over insulation passing through exterior walls, firewalls, fire partitions, floors, or roofs.

a. Metal jackets shall not be thinner than 0.006 inch thick aluminum, if corrugated, and 0.016 inch thick aluminum, if smooth.

b. Secure metal jackets with aluminum or stainless steel bands not less than 3/8 inch wide and not more than 8 inches apart. When penetrating roofs and before fitting the metal jacket into place, a 1/2 inch wide strip of sealant shall be run vertically along the inside of the longitudinal joint of the metal jacket from a point below the backup material to a minimum height of 36 inches above the roof. If the pipe turns from vertical to horizontal, the sealant strip shall be run to a point just beyond the first elbow. When penetrating waterproofing membrane for floors, the metal jacket shall extend from a point below

the back-up material to a minimum distance of 2 inches above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 12 inches above material to a minimum distance of 2 inches above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 12 inches above the floor; when passing through walls above grade, the jacket shall extend at least 4 inches beyond each side of the wall.

3.3.12.1 Pipes Passing Through Waterproofing Membranes

In addition to the pipe sleeves referred to above, pipes passing through waterproofing membranes shall be provided with a 4 pound lead flashing or 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 set over the membrane in a troweled coating of bituminous cement. The flashing shall extend above the roof or floor a minimum of 10 inches. 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. Pipes up to and including 10 inches in diameter which pass through waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

3.3.12.2 Optional Modular Mechanical Sealing Assembly

At the option of the Contractor, a modular mechanical type sealing assembly may be installed in the annular space between the sleeve and conduit or pipe in lieu of a waterproofing clamping flange and caulking and sealing specified above. The seals shall include interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion-protected carbon 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/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.3.12.3 Optional Counterflashing

As alternates to caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may consist of standard roof coupling for threaded pipe up to 6 inches in diameter, lead flashing sleeve for dry vents with the sleeve turned down into the pipe to form a waterproof joint, or a tack-welded or banded-metal rain shield around the pipe, sealed as indicated.

3.3.12.4 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.3.13 Balancing Valves

Balancing valves shall be installed as indicated.

3.3.14 Thermometer Wells

Provide a thermometer well in each return line for each circuit in multicircuit systems.

3.3.15 Air Vents

Install air vents in piping at all system high points. The vent shall remain open until water rises in the tank or pipe to a predetermined level at which time it shall close tight. An overflow pipe from the vent shall be run to a point designated by the Contracting Officer's representative. The inlet to the air vent shall have a gate valve or ball valve.

3.3.16 Escutcheons

Provide escutcheons at all finished surfaces where exposed piping, bare or insulated, 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 chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrews.

3.3.17 Drains

A drain connection with a 1 inch gate valve or 3/4 inch hose bib shall be installed at the lowest point in the return main near the boiler. In addition, threaded drain connections with threaded cap or plug shall be installed on the heat exchanger coil on each unit heater or unit ventilator and wherever required for thorough draining of the system.

3.3.18 Strainer Blow-Down Piping

Strainer blow-down connections shall be fitted with a black steel blow-down pipeline routed to an accessible location and provided with a blow-down valve.

3.3.19 Direct Venting for Combustion Intake Air and Exhaust Air

The intake air and exhaust vents shall be installed in accordance with NFPA 54 and boiler manufacturer's recommendations. The exhaust vent shall be sloped 1/4 inch/ft toward the boiler's flue gas condensate collection point.

3.4 GAS FUEL SYSTEM

Gas piping, fittings, valves, regulators, tests, cleaning, and adjustments shall be in accordance with the Section 23 11 20 FACILITY GAS PIPING. Submit proposed test schedules for the heating system and fuel system tests, at least 2 weeks prior to the start of related testing. NFPA 54 shall be complied with unless otherwise specified. Burners, pilots, and all accessories shall be listed in UL FLAMMABLE & COMBUSTIBLE. The fuel system shall be provided with a gas tight, manually operated, UL listed stop valve at the gas-supply connections, a gas strainer, a pressure regulator, pressure gauges, a burner-control valve, a safety shutoff valve suitable for size of burner and sequence of operation, and other

components required for safe, efficient, and reliable operation as specified. Approved permanent and ready facilities to permit periodic valve leakage tests on the safety shutoff valve or valves shall be provided.

3.5 COLOR CODE MARKING AND FIELD PAINTING

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS. Ferrous metal not specified to be coated at the factory shall be cleaned, prepared, and painted as specified in Section 09 90 00 PAINTS AND COATINGS. Exposed pipe covering shall be painted as specified in Section 09 90 00 PAINTS AND COATINGS. Aluminum sheath over insulation shall not be painted.

3.6 MANUFACTURER'S SERVICES

Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified to supervise the installing, adjusting, and testing of the equipment.

3.7 TEST OF BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assemblies shall be tested in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.8 HEATING SYSTEM TESTS

Submit the Qualifications of the firms in charge of installation and testing as specified. Submit a statement from the firms proposed to prepare submittals and perform installation and testing, demonstrating successful completion of similar services of at least five projects of similar size or scope, at least 2 weeks prior to the submittal of any other item required by this section. Before any covering is installed on pipe or heating equipment, the entire heating system's piping, fittings, and terminal heating units shall be hydrostatically tested and proved tight at a pressure of 1.5 times the design working pressure, but not less than 100 psi. Submit proposed test procedures for the heating system tests and fuel system tests, at least 2 weeks prior to the start of related testing.

a. Before pressurizing system for test, items or equipment (e.g., vessels, pumps, instruments, controls, relief valves) rated for pressures below the test pressure shall be blanked off or replaced with spool pieces.

b. Before balancing and final operating test, test blanks and spool pieces shall be removed; and protected instruments and equipment shall be reconnected. With equipment items protected, the system shall be pressurized to test pressure. Pressure shall be held for a period of time sufficient to inspect all welds, joints, and connections for leaks, but not less than 2 hours. No loss of pressure will be allowed. Leaks shall be repaired and repaired joints shall be retested.

c. Repair joints shall not be allowed under the floor for floor radiant heating systems. If a leak occurs in tubing located under the floor in radiant heating systems, the entire zone that is leaking shall be replaced. If any repair is made above the floor for floor radiant heating systems, access shall be provided for the installed joint.

Caulking of joints shall not be permitted.

d. System shall be drained and after instruments and equipment are reconnected, the system shall be refilled with service medium and maximum operating pressure applied. The pressure shall be held while inspecting these joints and connections for leaks. The leaks shall be repaired and the repaired joints retested.

Upon completion of hydrostatic tests and before acceptance of the installation, submit test reports for the heating system tests. Upon completion of testing complete with results, balance the heating system in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS and operating tests required to demonstrate satisfactory functional and operational efficiency. The operating test shall cover a period of at least 24 hours for each system, and shall include, as a minimum, the following specific information in a report, together with conclusions as to the adequacy of the system:

a. Certification of balancing.

b. Time, date, and duration of test.

c. Outside and inside dry bulb temperatures.

d. Temperature of hot water supply leaving boiler.

e. Temperature of heating return water from system at boiler inlet.

f. Quantity of water feed to boiler.

g. Boiler make, type, serial number, design pressure, and rated capacity.

h. Fuel burner make, model, and rated capacity; ammeter and voltmeter readings for burner motor.

i. Flue-gas temperature at boiler outlet.

j. Percent carbon dioxide in flue-gas.

k. Draft at boiler flue-gas exit.

l. Draft or pressure in furnace.

m. Quantity of water circulated.

n. Stack emission pollutants concentration.

Indicating instruments shall be read at half-hour intervals unless otherwise directed. Furnish all instruments, equipment, and personnel required for the tests and balancing. Obtain necessary natural gas, water and electricity as specified in the SPECIAL CONTRACT REQUIREMENTS Operating tests.

3.8.1 Water Treatment Testing

The boiler water shall be analyzed prior to the acceptance of the facility by the water treatment company. Submit a water quality test report identifying the chemical composition of the boiler water. The report shall include a comparison of the condition of the boiler water with the

manufacturer's recommended conditions. Any required corrective action shall be documented within the report. The test report shall identify the condition of the boiler at the completion of 1 year of service. The report shall include a comparison of the condition of the boiler with the manufacturer's recommended operating conditions. The analysis shall include the following information recorded in accordance with ASTM D596.

| | |
|---|---|
| Date of Sample | _____ |
| Temperature | _____ degrees F |
| Silica (SiO2) | _____ ppm (mg/1) |
| Insoluble | _____ ppm (mg/1) |
| Iron and Aluminum Oxides | _____ ppm (mg/1) |
| Calcium (Ca) | _____ ppm (mg/1) |
| Magnesium (Mg) | _____ ppm (mg/1) |
| Sodium and Potassium (Na and K) | _____ ppm (mg/1) |
| Carbonate (HCO3) | _____ ppm (mg/1) |
| Sulfate (SO4) | _____ ppm (mg/1) |
| Chloride (C1) | _____ ppm (mg/1) |
| Nitrate (NO3) | _____ ppm (mg/1) |
| Turbidity | _____ ntu |
| pH | _____ |
| Residual Chlorine | _____ ppm (mg/1) |
| Total Alkalinity | _____ epm (meq/1) |
| Noncarbonate Hardness | _____ epm (meq/1) |
| Total Hardness | _____ epm (meq/1) |
| Dissolved Solids | _____ ppm (mg/1) |
| Fluorine | _____ ppm (mg/1) |
| Conductivity | _____ micro-mho/cm |

If the boiler water is not in conformance with the boiler manufacturer's recommendations, the water treatment company shall take corrective action.

3.8.2 Boiler/Piping Test

At the conclusion of the 1 year period, the boiler piping shall be inspected 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, the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

3.9 CLEANING

3.9.1 Boilers and Piping

After the hydrostatic tests have been made and before the system is balanced and operating tests are performed, the boilers and piping shall be thoroughly cleaned by filling the system with a solution consisting of either 1 pound of caustic soda or 1 pound of trisodium phosphate per 50 gallons of water. The proper safety precautions shall be observed in the handling and use of these chemicals. The water shall be heated to approximately 150 degrees F and the solution circulated in the system for a period of 48 hours. The system shall then be drained and thoroughly flushed out with fresh water. Strainers and valves shall be thoroughly cleaned. Prior to operating tests, air shall be removed from all water systems by operating the air vents.

3.9.2 Heating Units

Inside space heating equipment, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for fans that are operated during construction, and new provide filters after construction dirt has been removed from the building, and the ducts, plenum, 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. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.10 FIELD TRAINING

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests.

a. The field instructions shall cover all of the items contained in the approved operation and maintenance manuals, as well as demonstrations of routine maintenance operations and boiler safety devices.

b. Submit system layout 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, framed under glass or laminated plastic, at least 2 weeks prior to the start of related testing. After approval, these items shall be posted where directed.

c. Submit six complete operation and maintenance instructions listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

d. Notify the Contracting Officer at least 14 days prior to date of proposed conduction of the training course.

## 3.11 FUEL SYSTEM TESTS

Submit test reports for the fuel system tests, upon completion of testing complete with results.

### 3.11.1 Gas System Test

The gas fuel system shall be tested in accordance with the test procedures outlined in NFPA 54.

-- End of Section --

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DECENTRALIZED UNITARY HVAC EQUIPMENT
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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-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

| | |
|---|---|
| AHRI 340/360 I-P | (2015) Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment |
| AHRI 410 | (2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils |
| AHRI 540 | (2015) Performance Rating Of Positive Displacement Refrigerant Compressors And Compressor Units |
| 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 370 | (2015; Addendum 1 2016) Sound Rating of Large Outdoor Refrigerating and Air-Conditioning Equipment |
| ANSI/AHRI 460 | (2005) Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers |
| ANSI/AHRI 495 | (2005) Performance Rating of Refrigerant Liquid Receivers |

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 55 | (2010) Thermal Environmental Conditions for Human Occupancy |
| ASHRAE 62.1 | (2019) Ventilation for Acceptable Indoor Air Quality |
| ASHRAE 90.1 - IP | (2019; Errata 1 2019; Errata 2-6 2020; Addenda BY-CP 2020; Addenda AF-DB 2020; Addenda A-G 2020; Addenda F-Y 2021; Errata 7-8 2021; Interpretation 1-6 2021; Addenda AS-BF 2022) Energy Standard for Buildings Except Low-Rise Residential Buildings |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| 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 Z49.1 | (2021) Safety in Welding and Cutting and Allied Processes |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| 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 |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA ICS 6 | (1993; R 2016) Industrial Control and Systems: Enclosures |
| NEMA MG 1 | (2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31 |

| | |
|---|---|
| NEMA MG 2 | (2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 207 | (2009; Reprint Jan 2020) Refrigerant-Containing Components and Accessories, Nonelectrical |
| 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 |

## 1.2 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

Spare Parts

Posted Instructions

System Performance Tests

Training; G-RO

Inventory

Manufacturer's Standard Catalog Data

SD-06 Test Reports

Refrigerant Tests, Charging, and Start-Up; G-RO

System Performance Tests; G-RO

SD-07 Certificates

Service Organizations

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G-RO

SD-11 Closeout Submittals

Ozone Depleting Substances; G-RO

1.3 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

1.4 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, cap piping and similar openings capped to keep out dirt and other foreign matter.

1.5 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. Thermal comfort must meet or exceed ASHRAE 55.

1.6 WARRANTY

Provide equipment with the Manufacturer's Standard Warranty.

## PART 2 PRODUCTS

### 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, 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.

#### 2.1.1 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.

#### 2.1.2 Product Sustainability Criteria

##### 2.1.2.1 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.

##### 2.1.2.2 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.

2.1.2.3 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.

2.1.2.4 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mileradius from the project site, if available from a minimum of three sources.

2.1.3 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.

2.1.4 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.

2.2 EQUIPMENT

2.2.1 Split-System Air Conditioners

2.2.1.1 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 indoor unit, and interconnecting refrigerant piping. Provide the air conditioning type unit conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit must be rated in accordance with ANSI/AHRI 210/240 or AHRI 340/360 I-P. 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 may be propeller type. Design unit to operate at outdoor ambient temperatures up to 115 degrees F.

2.2.1.1.1 Air-to-Refrigerant Coil

Provide condensing coils with copper tubes of 3/8 inch minimum diameter with aluminum fins that are mechanically bonded or soldered to the tubes. Casing must be galvanized steel. 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.

2.2.1.1.2 Compressor

Provide direct drive scroll type compressor.Provide compressor with internal over temperature and pressure protector; sump heater; oil pump; high pressure and low pressure controls; and liquid line dryer.

2.2.1.1.3 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.

2.2.1.1.4 Unit Controls

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. Control unit by a programmable electronic thermostat with heating setback and cooling setup with 7-day programming capability.

2.2.1.1.5 Condensing Coil

Provide coils with copper tubes of 3/8 inch minimum diameter with aluminum fins that are mechanically bonded or soldered to the tubes. Provide galvanized steel or aluminum casing. Avoid contact of dissimilar metals. Test coils in accordance with ANSI/ASHRAE 15 & 34 at the factory and ensure suitability for the working pressure of the installed system. Dehydrate and seal eacj coil after testing and prior to evaluation and charging. Provide separate expansion devices for each compressor circuit.

2.2.1.1.6 Remote Condenser or Condensing Unit

Fit each remote condenser coil fitted with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing temperature must not exceed 120 degrees F at 104 degrees F ambient. Provide unit with low ambient condenser controls to ensure proper operation in an ambient temperature of minus 20 degrees F. Provide fan and cabinet construction as specified in paragraph UNITARY EQUIPMENT ACCESSORIES.

2.2.1.1.6.1 Air-Cooled Condenser

Provide Unit in accordance with ANSI/AHRI 460 and conform to the requirements of UL 1995. Provide factory fabricated, tested, packaged, and self-contained unit; complete with casing, propeller type fans, heat rejection coils, connecting piping and wiring, and all necessary accessories.

2.2.1.1.7 Air Filters

Provide filters of the panel type that are capable of filtering the entire air supply. Mount filter(s) integral within the unit and make accessible by hinged access panel(s). 1 inch MERV 8, provide throwaway filter on all units below 6 Tons.

2.2.1.1.8 Fans

Provide direct driven, statically and dynamically balanced, centrifugal 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.

2.2.1.2 Large-Capacity Split-System Air Conditioners (Greater Than 65,000 Btu/h)

Provide an air-cooled, split system which employs a remote condensing unit, a separate floor mounted indoor unit, and interconnecting refrigerant piping. Provide the air conditioning type unit conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit must be rated in accordance with ANSI/AHRI 210/240. Provide unit with necessary fans, air filters, and cabinet construction as specified in paragraph UNITARY EQUIPMENT ACCESSORIES. Provide double-width, double inlet, backward inclined airfoil blade type evaporator or supply fans. Provide the manufacturer's standard for the unit specified and may be propeller type condenser or outdoor fans.

2.2.1.2.1 Air-To-Refrigerant Coil

Provide coils with copper tubes tubes of 3/8 inch minimum diameter with aluminum fins that are mechanically bonded or soldered to the tubes. Provide casing of galvanized steel. 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. Provide each unit with a factory operating charge of refrigerant and oil. Field charge unit shipped with a holding charge with refrigerant and oil. Provide separate expansion devices for each compressor circuit.

2.2.1.2.2 Compressor

Provide direct drive, semi-hermetic or hermetic reciprocating, or scroll type compressor capable of operating at partial load conditions. Compressor must be capable of continuous operation down to the lowest step of unloading as specified. Equip compressors of 10 tons and larger with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors operate in sequence, and each

compressor has an independent refrigeration circuit through the condenser and evaporator. Start compressors in the unloaded position. Provide each compressor with vibration isolators, crankcase heater, thermal overloads, lubrication pump, high and low pressure safety cutoffs and protection against short cycling.

2.2.1.2.3 Refrigeration Circuit

Refrigerant-containing components must comply with ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Provide refrigerant charging valves and connections, and pumpdown valves for each circuit. Provide reversible-flow type filter-drier in each liquid line. Refrigerant flow control devices must be an adjustable superheat thermostatic expansion valve with external equalizer matched to coil, capillary or thermostatic control, and a pilot solenoid controlled, leak-tight, four-way refrigerant flow reversing valve. Provide a refrigerant suction line thermostatic and water flow switch control to prevent freeze-up in event of loss of water flow during heating cycle.

2.2.1.2.4 Primary/Supplemental Heat

2.2.1.2.4.1 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.

2.2.1.2.5 Unit Controls

Provide unit internally prewired with a 120 volt control circuit powered by an internal transformer. Provide terminal blocks for power wiring and external control wiring. Unit must have cutoffs for high and low pressure, and low oil pressure for compressors with positive displacement oil pumps, supply fan failure, and safety interlocks on all service panels. Head pressure controls must sustain unit operation with ambient temperature of minus 20 degrees F. Adjustable-cycle timers must prevent short-cycling. Stage multiple compressors by means of a time delay. Internally protect unit by fuses in accordance with UL 1995. Make low cost cooling possible by means of a control circuit which will modulate dampers to provide 100 percent outside air while locking out compressors.

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.

2.2.1.2.6 Remote Condenser or Condensing Unit

Units with capacities 135,000 Btuh or greater must produce a maximum AHRI sound rating of 85 dB when rated in accordance with ANSI/AHRI 370. Fit each remote condenser coil with a manual isolation valve and an access valve on the coil side. Saturated refrigerant condensing temperature must not exceed 120 degrees F at 95 degrees F ambient. Provide unit with low ambient condenser controls to ensure proper operation in an ambient temperature of minus 20 degrees F. Provide fan and cabinet construction must be provided as specified in paragraph UNITARY EQUIPMENT COMPONENTS.

2.2.1.2.6.1 Air-Cooled Condenser

Provide unit rated in accordance with ANSI/AHRI 460 and conform to the requirements of UL 1995. Provide factory fabricated, tested, packaged, and self-contained unit. Unit must be complete with casing, propeller or centrifugal type fans, heat rejection coils, connecting piping and wiring, and all necessary appurtenances.

a. Provide interconnecting refrigeration piping, electrical power, and control wiring between the condensing unit and the indoor unit as required and as indicated. Provide electrical and refrigeration piping terminal connections between condensing unit and evaporator units.

b. Low ambient control for multi-circuited units serving more than one evaporator coil must provide independent condenser pressure controls for each refrigerant circuit. Set controls to produce a minimum of 95 degrees F saturated refrigerant condensing temperature. Provide unit with a liquid subcooling circuit that ensures proper liquid refrigerant flow to the expansion device over the specified application range of the condenser. Unit must be provided with manufacturer's standard liquid subcooling. Liquid seal the subcooling circuit.

c. Coils must have copper or aluminum 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 after testing and prior to evaluation and charging. 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 separate expansion devices for each compressor circuit.

d. Provide a complete control system with required accessories for regulating condenser pressure by fan cycling, solid-state variable fan speed, modulating condenser coil or fan dampers, flooding the condenser, or a combination of the above. Construct unit mounted control panels or enclosures in accordance with applicable requirements of NFPA 70 and house in NEMA ICS 6, Class 1 or 3A enclosures. Controls must include control transformer, fan motor starters, time delay start-up, overload protective devices, interface with local and remote components, and intercomponent wiring to terminal block points.

2.2.1.2.6.2 Compressor

Provide compressor rated in accordance with AHRI 540. Provide direct drive, semi-hermetic or hermetic reciprocating, or scroll type compressor capable of operating at partial load conditions. Compressor must be capable of continuous operation down to the lowest step of unloading as specified. Provide units 120,000 Btuh and larger with capacity reduction devices to produce automatic capacity reduction of at least 50 percent. If standard with the manufacturer, two or more compressors may be used in lieu of a single compressor with unloading capabilities, in which case the compressors operate in sequence, and each compressor must have an independent refrigeration circuit through the condenser and evaporator. Each compressor must start in the unloaded position. Provide each

compressor with vibration isolators, crankcase heater, lubrication pump, thermal overloads, and high and low pressure safety cutoffs and protection against short cycling.

2.2.1.2.6.3 Fans

Provide fan wheel shafts supported by either maintenance-accessible grease lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Mount fan motor and fan assembly on a common base to allow consistent belt tension with no relative motion between fan and motor shafts. The entire fan motor and fan assembly must be completely vibrationally isolated from the unit. Select unit fans to produce the cfm required at the fan total pressure. Provide automatic-reset type thermal overload protection. Construct fan wheels of aluminum or galvanized steel. Statically and dynamically balance propellers. Condenser fans must be propeller type, direct drive, statically balanced with galvanized steel blades and permanently lubricated ball bearings. Protect condenser fan motor drive bearings with water slingers or shields.

2.2.1.2.7 Filters

Provide filters of the panel type, capable of filtering the entire air supply. Mount filter(s) integral within the unit and make accessible. Factory supply 2.0 inch, MERV 13, throwaway filters. Filters must have an average dust spot efficiency of 90-95 percent and an average arrestance of 90 percent when tested in accordance with ASHRAE 52.2. Provide UL Class 1 filters.

2.3 COMPONENTS

2.3.1 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.

2.3.2 Primary/Supplemental Heating

2.3.2.1 Water Coil

Coil must conform to the provisions of AHRI 410. Coil must be fin-and-tube type constructed of seamless copper tubes and aluminum fins mechanically bonded or soldered to tubes. Headers must be constructed of cast iron, welded steel or copper. Coil must be constructed to float within the casing to allow free expansion and contraction of tubing. Casing and tube support sheets must not be lighter than 16 gauge galvanized steel formed to provide structural strength. When required, multiple tube supports must be provided to prevent tube sag. Coil must be circuited for suitable water velocity without excessive pressure drop and properly pitched for drainage where required or indicated. Each coil must be tested at the factory under water at not less than 300 psi air pressure, tested hydrostatically after assembly of the unit and proved tight under a gauge pressure of 200 psi. Coil must be suitable for use with water up to 250 degrees F. Coil must allow complete coil drainage

with a pitch of not less than 1/8 inch/foot slope to drain.

2.3.3 Air Filters

Provide filters to filter outside air and return air and locate inside air conditioners. Provide replaceable (throw-away) type. Filters must conform to UL 900, Class 1. Polyurethane filters cannot be used on units with multiframe filters.

Air filters must be listed in accordance with requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test Method must be as listed under the label service and must meet the requirements of UL 586.

2.3.3.1 Extended Surface Pleated Panel Filters

Filters must be 2 inch depth sectional type of the size indicated and must have an average efficiency of 25 to 30 percent when tested in accordance with ASHRAE 52.2. Initial resistance at 500 feet/minute must not exceed 0.36 inches water gauge. Filters must be UL Class 2. Media must be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media must be attached to a moisture resistant fiberboard frame. Four edges of the filter media must be bonded to the inside of the frame to prevent air bypass and increase rigidity.

2.3.3.2 Manometers

Provide inclined-type manometers for filter stations of 2,000 cfm capacity or larger including filters furnished as integral parts of air-handling units and filters installed separately. Provide sufficient length to read at least one inch of water column with 10 major graduations, and equipped with spirit level. Equip manometers with overpressure safety traps to prevent loss of fluid, and two three-way vent valves for checking zero setting. Mercury cannot be used as the operating fluid.

2.3.4 Coil Frost Protection

Provide each circuit with a manufacturer's standard coil frost protection system. The coil frost protection system must use a temperature sensor in the suction line of the compressor to shut the compressor off when coil frosting occurs. Use timers to prevent the compressor from rapid cycling.

2.3.5 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. Refrigerant wetted carbon steel surfaces must be pickled or abrasive blasted free of mill scale, cleaned, dried, charged, and sealed.

2.3.5.1 Liquid Receiver

A liquid receiver must be provided when a system's condenser or compressor does not contain a refrigerant storage capacity of at least 20 percent in excess of a fully charged system. Receiver must be designed, filled, and rated in accordance with the recommendations of ANSI/AHRI 495, except as modified herein. Receiver must be fitted to include an inlet connection; an outlet drop pipe with oil seal and oil drain where necessary; two

bull's-eye liquid level sight glass in same vertical plane, 90 degrees apart and perpendicular to axis of receiver or external gauge glass with metal guard and automatic stop valves; and purge, charge, equalizing, pressurizing, plugged drain and service valves on the inlet and outlet connections. Receiver must be provided with a relief valve of capacity and setting in accordance with ASHRAE 15 & 34.

2.3.5.2 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. Pressure drop through a separator must not exceed 10 psi during the removal of hot gas entrained oil. 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, filter for removal of all particulate sized 10 microns and larger, thermometer and low temperature thermostat fitted to thermal well, and strainer.

2.3.5.3 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.

2.3.6 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 automatic modulation and operate as specified.

2.3.7 Cabinet Construction

Casings for the specified unitary equipment must be constructed of galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Minimum thickness of single wall exterior surfaces must be 18 gauge galvanized steel or 0.071 inch thick aluminum on units with a capacity above 20 tons and 20 gauge galvanized steel or 0.064 inch thick aluminum on units with a capacity less than 20 tons. Casing must be fitted 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. Where double-wall insulated construction is proposed, minimum exterior galvanized sheet metal thickness must be 20 gauge. Provisions to permit replacement of major unit components must be incorporated. Penetrations of cabinet surfaces, including the floor, must be sealed. Unit must be fitted with a drain pan which extends under all areas where water may accumulate. Drain pan must be fabricated from Type 300 stainless steel, galvanized steel with protective coating as required, or an approved plastic material. 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. Paint

and finishes must comply with the requirements specified in paragraph FACTORY COATING.

2.3.7.1 Indoor Cabinet

Indoor cabinets must be suitable for the specified indoor service and enclose all unit components.

2.3.7.2 Outdoor Cabinet

Outdoor cabinets must be suitable for outdoor service with a weathertight, insulated and corrosion-protected structure. Cabinets constructed exclusively for indoor service which have been modified for outdoor service are not acceptable.

2.3.8 Refrigerant Piping

Provide refrigerant piping in accordance with Section 23 23 00 REFRIGERANT PIPING.

2.3.9 Condensate Drain Piping

provide condensate drain piping in accordance with Section 23 05 15 COMMON PIPING FOR HVAC.

2.3.10 Ductwork

Provide ductwork in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

2.3.11 Temperature Controls

Provide temperature controls in accordance with Section 23 09 23.02 BACnet DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDNG CONTROL SYSTEMS.

2.4 UNITARY EQUIPMENT ACCESSORIES AND MISCELLANEOUS EQUIPMENT

2.4.1 Air Economizer

Provide factory installed economizer with fully modulating 0-100 percent motor and dampers, barometric relief, minimum position setting and fixed dry bulb.

2.5 FINISHES

2.5.1 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 125 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.

2.5.1.1 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.

2.5.2 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.

2.6 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 D1and 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 10-20 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 TRAINING

Conduct a training course for the operating staff as designated by the Contracting Officer. The training period must consist of a total 8 hours

of normal working time and start after the system is functionally completed but prior to final acceptance tests.

a. Submit a schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

b. 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. 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 be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

c. 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. Submit 6 complete copies of an operation manual 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 at least 4 weeks prior to the first training course. The booklets must include the manufacturer's name, model number, and parts list. The manuals must include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features.

d. Submit 6 complete copies of maintenance manual in bound 8-1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

## 3.5 REFRIGERANT TESTS, CHARGING, AND START-UP

Split-system refrigerant piping systems must be tested and charged as specified in Section 23 23 00 REFRIGERANT PIPING. 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.

### 3.5.1 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.

3.5.2 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.

3.6 SYSTEM PERFORMANCE TESTS

Before each refrigeration system is accepted, conduct tests to demonstrate the general operating characteristics of all equipment by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Six 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.

For equipment providing heating and cooling the system performance tests must be performed during the heating and cooling seasons.

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. Replace any refrigerant lost during the system startup.

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 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit 6 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) Thermostatic 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.

## 3.7 MAINTENANCE

### 3.7.1 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.

### 3.7.2 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.

-- End of Section --

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SECTION 25 05 11.21

CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS
FIRE AND LIFE SAFETY SYSTEMS
**05/21**

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 https://public.cyber.mil/stigs/downloads/ and an SRG/STIG Applicability Guide and Collection Tool is available at https://public.cyber.mil/stigs/SCAP/. Not all control system components have applicable STIGs or SRGs. The "Control Systems SRG" does not apply to work performed under this Section; all requirements within this section to apply applicable SRGs DO NOT include the "Control Systems SRG".

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: Fire And Life Safety Systems, including Fire Alarm Reporting System and Fire Suppression System.

1.2 RELATED REQUIREMENTS

This section does not contain sufficient requirements to procure a control system and must be used in conjunction with other Sections which specify control systems. This Section adds cybersecurity requirements to the control systems specified in other Sections, to include without constraint Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE, and as these requirements are conditioned on the control system being provided, there may be requirements in this Section that will not apply to this project. 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.

In cases where a requirement is specified in both this Section and in another Section, the more stringent requirement must be met. In cases where a requirement in this Section conflicts with the requirements of another Section such that both requirements cannot be met at the same time, request direction from the Contracting Officer Representative to determine which requirement applies to the project.

## 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.

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

| | |
|---|---|
| NIST FIPS 140-2 | (2001) Security Requirements for Cryptographic Modules |

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 Administrator Account

An administrator account is an account with full permissions to a device, application, or operating system, including the ability to create and modify other user accounts.

Note that the operating system Administrator Account may be different than Administrator Accounts for applications hosted on that operating system. Also, most controllers will not have any support for accounts and will therefore not have an 'Administrator Account'.

### 1.4.2 Computer

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 Operating System, where Android is considered separate from Linux

e. a device running a version of Apple iOS

Unless otherwise indicated or clear from context use of the word "device" in this Section includes computers.

### 1.4.3 Controller

A device other than a computer or Ethernet switch. For Fire Protection systems this includes fire alarm control panels, remote operating consoles, and remote annunciators.

1.4.4 Mission Space

A device or media is in mission space if physical access to the device or media is controlled by the organization served by the device. For example, a VAV box controller in a suspended ceiling is in mission space if the VAV box serves that room; an electrical switchgear in an electrical room or an AHU in a mechanical room or on a rooftop may still be considered to be in mission space if the organization (mission) served by that switchgear or AHU controls access to the electrical room, mechanical room or rooftop.

1.4.5 Network

A network is a group of two or more devices that can communicate using a network protocol. Network protocols must provide a method for addressing devices on the network; a communication method that does not provide an addressing scheme is not a networked form of communication. Devices that communicate using a method of communication that does not support device addressing are not using a network.

1.4.6 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 (unlike many IT definitions of "Network Connected") 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).

1.4.6.1 Wireless Network Connected

Any device that supports wireless network communication is network connected to a wireless network, regardless of whether the device is communicating using wireless. Unless physically disabled, devices with wireless transceivers support wireless, it is not sufficient to disable the wireless in software.

1.4.7 Network Media

The thing that provides the communication channel between the devices on a network. Typically wire, but might include wireless, fiber optic, or even power line (some network protocols allow sending network signals over power wiring).

1.4.8 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

1.4.8.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts. These devices support user-based (as opposed to role-based) authentication.

1.4.8.2 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 "username and password" structure). These devices typically only support role-based authentication.

Examples of devices which MINIMALLY support accounts are a) a variable frequency drive with a single account which requires a PIN for access to configuration; and b) a room lighting control touchpad interface that has a single account.

1.4.8.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.9 Manual Local Input

Manual Local Inputs are system analog or binary inputs that are adjustable by a person but are, by intrinsic hardware design, very limited in potential capabilities. Manual Local Inputs do not have touch screens or full keyboards, but may have a few buttons or dials to allow input. Manual Local Inputs do not have full graphic screens or dot-matrix displays, but may have simple lights (LEDs) or 7-segment displays. Manual Local Inputs do not have any sort of menu structure, each button has a single well-defined function.

Examples of Manual Local Inputs are H-O-A switches, simple thermostats, and disconnect switches.

1.4.10 Card Reader

A card reader is an input/output device whose primary function is to assist in two-factor authentication. A card reader must have an interface to read data from a card and may be able to write data to a card. A card reader may have a means (such as buttons, keypad, touchscreen, etc.) for a user to input a PIN or password, as well as a limited display.

1.4.11 User Interface

A User Interface (UI) is something other than a Manual Local Input or Card Reader that allows a person to interact with the system or device. Note that while a Card Reader is not by itself a User Interface, a User Interface may contain a Card Reader in order for it to authenticate its user. Within control systems, there are a wide range of User Interfaces.

Two important distinctions are 1) whether the user interface is Local or Remote, and 2) the effective capabilities of the User Interface to alter data, which is the "privilege" of the user interface (where effective privilege available to a specific user at a specific user interface is the combination of the greatest privilege offered by the user interface and the specific account the user is logged into).

#### 1.4.11.1 Local User Interface

A Local User Interface is a user interface where the physical hardware the user interacts with (keyboard, buttons, display, etc.) is physically part of the device being affected. All of the relevant characteristics of the user interface are embodied within a single device.

Note that a Local UI may be able to access data in a different device, Local versus Remote in this context refers to the user interface itself; the capability to access data in a different device is covered under "Full User Interface".

#### 1.4.11.2 Remote User Interface

A Remote User Interface implements a Client/Server model where the physical hardware the user interacts with (Client) is physically distinct from the device being affected (Server). Most or all of the security and functionality characteristics of the user interface are defined by the Server, not the Client. The Client and Server communicate via a network connection. A common example of a remote user interface is a web-based interface where the browser (client) is generally on different hardware than the web server (server). A Remote UI remains a Remote UI even if the user happens to be at a Client on the same hardware as the Server. What is important is that a) the Client may be on different hardware than the Server and b) the majority of the security and functional characteristics of the interface are defined at the Server.

Note that this definition of "remote" is consistent with that generally used in the control industry but is not aligned with the NIST 800-53 definition of "Remote", which refers to "outside the system". The term "Remote" here better aligns with the NIST 800-53 definition of "Network" (remote from within the system) Access.

#### 1.4.11.3 Types of User Interface (by capability)

User interfaces are also categorized by their capabilities as being Read Only, Limited, or Full.

##### 1.4.11.3.1 Read-Only User Interface

A Read Only User Interface (also referred to as a View-Only User Interface) is a user interface that only allows for reading data, it does not allow (have the capability to) modify data. A Read Only User Interface may be either Local or Remote. A User Interface that is configured to be Read Only (by some other means than the interface itself, such as using configuration software on a laptop) is a Read-Only Interface. Note a Read Only User Interface may have buttons (or touch screen, etc.) allowing the user to navigate through the presentation of data.

Examples of a Read Only User Interfaces are a) a publicly viewable "energy dashboard" showing weather data and energy usage within a building and b) digital wayfinding signage.

##### 1.4.11.3.2 Limited User Interface

A Limited User Interface is a user interface that - by design - can only alter information local to the user interface. Note that the determination of "alter" includes only direct interactions, it explicitly excludes

interactions that might occur as secondary effects. For example, an interface changing the flow setpoint in a pump controller is a direct interaction, the subsequent change in flow (as well as any subsequent downstream changes in valve position) are not direct interactions.

Two examples of LIMITED UIs are: a) a variable speed drive has a Limited Local User Interface which allows the user to change properties within the drive, but does not allow affecting things outside the drive; and b) a typical home WiFi Router has a Limited Remote User Interface which allows configuration of the Router, but does not allow direct interaction with other devices.

1.4.11.3.3 Full User Interface

A Full User Interface can alter information in devices outside the device with the user interface. For example, a typical Local Display Panel is a Full Local User Interface while a browser-based front end is a Full Remote User Interface.

1.4.11.3.4 View-Only User Interface

See Read-Only User Interface

1.4.11.4 Other User Interface Terminology

In addition to defining whether a user interface is a Hardware Limited, Read-Only, Limited or Full, and whether it is Local or Remote, user interfaces are classified by whether they are writable or privileged.

1.4.11.4.1 Writable User Interface

Any User Interface that is not Read-Only is Writable. (Limited User Interfaces and Full User Interfaces are both writable user interfaces (as they are capable of changing a value)).

1.4.11.4.2 Privileged User Interface

A Privileged UI is a UI that has sufficient capabilities or functionality that it requires specific cybersecurity measures to be put in place to limit its unauthorized use. Ultimately, whether a specific user interface is considered a Privileged User Interface must be determined by usage. Unless otherwise specified, user interfaces can be determined to be privileged or not using the following:

a. Read-Only User Interfaces are not privileged user interfaces.

b. Full User interfaces for Fire Alarm Systems are privileged user interfaces as indicated and shown, or when another requirement of this Section establishes they are privileged. For all other systems, Full User Interfaces are privileged user interfaces.

c. User interfaces that allow for configuration of auditing or allows for modification or deletion of audit logs are privileged user interface.

d. User interfaces that allow for reprogramming a network connected device is a privileged user interface.

e. For Fire Protection Systems, User Interfaces that can inhibit or force the activation of a fire suppression system (e.g. such as for a

pre-action or deluge system) are privileged user interfaces.

e. Except as specified above, a Limited User Interface must be determined to be privileged or not based on the specific capabilities and use case of the user interface. In general however, user interfaces that do not offer significant capabilities above and beyond those available at that location via other means (e.g. such as a disconnect switch, breaker, or hand-off-auto switch, or physical attack) are not privileged.

1.4.12 Wireless Network

Any network that communicates without using wires or fiber optics as the communication media. Wireless networks include: WiFi, Bluetooth, ZigBee, cellular, satellite, 900 MHz radio, 2.4 GHz, free space optical, point-to-point laser, and IR.

1.4.13 Wired Broadcast Network

Wired Broadcast Networks are any network, such as powerline carrier networks and modem (wired telephony), that use wire-based technologies where there is not a clearly defined boundary for signal propagation.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Points of Contact

Coordinate with the following Points of Contact as indicated in this Section and as required. Not all projects will require coordination with all Points of Contact. When coordination is required and no Point of Contact is indicated, coordinate with The Contracting Office Representative (COR).

a. Government Device Access Point of Contact: The Contracting Office Representative (COR)

b. HTTPS Certificate Point of Contact: The Contracting Office Representative (COR)

c. Email Address Point of Contact: The Contracting Office Representative (COR)

d. Password Point of Contact: The Contracting Office Representative (COR)

e. Mobile Code Point of Contact: The Contracting Office Representative (COR)

f. PKI Infrastructure Point of Contact: The Contracting Office Representative (COR)

g. Fire Protection Point of Contact: 28 CES/CEOF Representative - Bradley France

1.5.2 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 or wired broadcast communication, approval must be obtained prior to control system device selection and installation.

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 installation.

c. If requesting permission for the use of a device with multiple physical connections to IP networks, the Multiple IP Connection Device Request must be approved prior to control system device selection and installation.

d. 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.

e. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.

f. Passwords must be coordinated with the indicated contact for the project site.

g. If applicable, HTTPS web server certificates must be obtained from the indicated HTTPS Certificate Point of Contact.

h. Contractor Computer Cybersecurity Compliance Statements must be provided for each contractor using contractor owned computers.

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-01 Preconstruction Submittals

Device Account Lock Exception Request; G-RO

Contractor Computer Cybersecurity Compliance Statements; G-RO

Contractor Temporary Network Cybersecurity Compliance Statements; G -RO

Cybersecurity Subject Matter Expert Qualifications; G-RO

SD-02 Shop Drawings

Network Communication Report; G-AE

Cybersecurity Riser Diagram; G-AE

SD-03 Product Data

Control System Cybersecurity Documentation; G-AE

SD-06 Test Reports

Control System Cybersecurity Testing Procedures; G-RO

Control System Cybersecurity Testing Report; G-RO

SD-07 Certificates

Software Licenses; G-RO

SD-11 Closeout Submittals

Password Change Summary Report; G-RO

Enclosure Keys; G-RO

Software and Configuration Backups; G-RO

Auditing Front End Software; G-RO

Device Audit Record Upload Software; G-RO

System Maintenance Tool Software; G-RO

Vendor Guide Compliance Result Report; G-RO

Control System Inventory Report; G-AE

Integrity Verification Software; G-RO

## 1.7 QUALITY CONTROL

### 1.7.1 Qualifications

For the positions listed below resumes should be submitted to the Government within 14 days after notice to proceed. All certifications must be in effect prior to being hired.

These positions may serve across the contract.

### 1.7.2 Cybersecurity Subject Matter Expert Qualifications

The individual will oversee all work within this specification. This position requires that the individual currently meet Information Assurance Manager Level II in accordance with DoD 8570.01-M, Information Workforce Improvement Program, and DoD 8140.01, Cyberspace Workforce Management Program.

## 1.8 CYBERSECURITY DOCUMENTATION

{For Government Reference Only: This subpart (and its subparts) relates to PL-7; CCI-003071}

### 1.8.1 Network Communication Report

{For Government Reference Only: This subpart (and its subparts) relates to CA-9, PL-8; CCI-003075; CCI-002102, CCI-002103, CCI-002104, CCI-002105, CCI-003072, CCI-003073, CCI-003075 and also the submittal requirements associated with CM-6, CM-7, SC-8 and SC-41 including CM-7(3), CCI-000388.}

Provide a network communication report. For each networked device, document the communication characteristics of the device including communication protocols, services used, encryption employed, and a general description of what information is communicated over the network. For each device using IP, document all TCP and UDP ports used. For non-IP communications, document communication protocol and media 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.

1.8.2 Control System Inventory Report

{For Government Reference Only: This subpart (and its subparts) relates to CM-8(a), SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, 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 https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 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.

1.8.3 Software and Configuration Backups

{For Government Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each device on which software is installed under this project, provide a recovery image of the final as-built device. 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. If additional user permissions are required to meet this requirement, coordinate the creation of the image with the identified Government Device Access Point of Contact.

For all controllers, provide a backup of the controller configuration and the source code for all loaded application programs (all software that is not common to every controller of the same manufacturer and model).

If any or all of these are provided under another Section, provide documentation indicating this and referencing those submittals.

1.8.4 Cybersecurity Riser Diagram

{For Government Reference Only: This subpart (and its subparts) relates to PL-2(a), PL-8; CCI-003051, CCI-003053, CCI-003072, CCI-003073,

CCI-003075}

Provide a cybersecurity riser diagram of the complete control system including all network and device 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.

1.8.5 Vendor Guide Compliance Result Report

For every component (device or software) with manufacturer provided cybersecurity documentation, procedure, or method for secure configuration or installation, provide a report documenting how the component was configured and any deviation from the manufacturer instructions.

1.8.6 Control System Cybersecurity Documentation

{For Government Reference Only: 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.

1.8.6.1 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 Government Reference Only: relates to CCI-003124}

b. Documentation that describes secure installation of the device {For Government Reference Only: relates to CCI-003125}

c. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}

d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government 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 Government 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 Government 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 Government Reference Only: relates to CCI-003130}

h. Documentation that describes user responsibilities in maintaining the security of the device {For Government Reference Only: relates to CCI-003131}

## 1.9 SOFTWARE LICENSING

{For Government Reference Only: This subpart (and its subparts) relates to SI-2(a), SI-2(c), SI-7(14); CCI-001227, CCI-002605, CCI-002737}

For all software provided that has not already been licensed to the government or project site, provide a license to the Government for a period of no less than 5 years, and the license must also include the following software updates:

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

## 1.10 CYBERSECURITY DURING CONSTRUCTION

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, SA-3; CCI-000258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

### 1.10.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. Contractor computers connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

#### 1.10.1.1 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.

#### 1.10.1.2 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. Computers used on this project must be scanned using the installed software at least once per day.

#### 1.10.1.3 Passwords and Passphrases

The passwords and passphrases for computers, applications, and web-based applications supporting passwords 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.

1.10.1.4 User-Based Authentication

Each user must have a unique account; sharing of a single account between multiple users is prohibited.

1.10.1.5 Demonstration of Compliance

The Government has the right to require demonstration of computer compliance with these requirements at any time during the project.

1.10.1.6 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 https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 Each Statement must be signed by a cybersecurity representative for the relevant company.

1.10.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than those specifically provided or furnished for this project. Any and all access to the network from outside the project site is prohibited.

1.10.3 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.

1.10.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks, when permitted, must not interfere with existing wireless networks, must use WPA2 security and must not broadcast the network name (SSID). Network names (SSID) for wireless networks must be changed from their default values.

1.10.5 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.

1.10.6 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 https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 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.

1.11 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 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES

Install, configure, and harden all hardware and software furnished on this project in accordance with manufacturer provided documentation, procedures, or methods for secure configuration or installation. Do not implement specific hardening actions if that action would conflict with requireed functionality or another requirement of this Section.

3.2 NETWORK REQUIREMENTS

3.2.1 Information Flow Enforcement In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relate to AC-4; CCI-001368, CCI-001414, CCI-001548, CCI-001549, CCI-001550, CCI-001551}

Install and configure Ethernet switches to block all traffic on all ports not required by the control protocol.

3.2.2 Wireless and Wired Broadcast Communication for Fire Protection Systems

The use of wireless and wired broadcast communication for fire protection systems within a facility is prohibited. Wireless communication may be used to provide communication from the fire protection system in a facility to the central monitoring station. Communication between the fire protection system and the central monitoring station must be via FIPS 140-2 certified devices.

3.2.3 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.

When control system specifications do not indicate requirements for

communication protocols, use only those protocols required for operation of the system as specified.

3.2.4 IP Control Networks

{For Government Reference Only: This subpart relates to CM-6(a), CM-7(a), CM-7(b), CM-7(1)(b), SC-41; CCI-001588, CCI-000381, CCI-000380, CCI-000381, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546. For Moderate Impact Systems, this subpart (and its subparts) also relates to SC-5(1), SC-5(2); CCI-001094 CCI-001095}

IP Networks must be Ethernet networks and must use switches which are Ethernet Switches or Daisy Chain IP Controllers as defined in this Section. 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.

For MODERATE Impact Systems, unless explicitly authorized, do not use IP networks if the same control functionality is available through the use of non-IP networks.

3.2.4.1 IP Network Routers

Do not install any device that performs IP routing.

3.2.5 Cryptographic Protection

{For Government Reference Only: This subpart relates to IA-2(9), IA-3(1), SC-8, SC-13, SC-23(1), SC-23(3); CCI-001942, CCI-001959, CCI-001967, CCI-002418, CCI-002449, CCI-002450, CCI-001185, CCI-001188, CCI-001664.}

All remote user interfaces must use HTTPS for all traffic between the user interface client and user interface server.

For devices that have STIG/SRGs related to cryptographic protection (CCI-002450), comply with the requirements of those STIG/SRGs. Ensure that all network traffic is encrypted using NSA-approved cryptography; provision of digital signatures and hashing, and FIPS-validated cryptography.

3.2.6 Device Identification and Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-3; CCI-000777, CCI-000778, CCI-001958. For MODERATE Impact systems, this subpart (and its subparts) also relates to SC-23, SC-23(5); CCI-001184, CCI-002470.}

3.2.6.1 Default Requirements for Control System Devices

For control system devices where Device Identification and Authentication requirements are not otherwise indicated in this Section: Devices using HTTP as a control protocol must use HTTPS instead.

3.2.7 Cryptographic Module Authentication

{For Government Reference Only: This subpart (and its subparts) relates

to IA-7; CCI-000803}

For devices (including but not limited to NIST FIPS 140-2 compliant radios) that have STIG/SRGs related to cryptographic module authentication (CCI-000803), comply with the requirements of those STIG/SRGs.

## 3.3 ACCESS CONTROL REQUIREMENTS

### 3.3.1 User Accounts

{For Government Reference Only: This subpart (and its subparts) relate to AC-2(a), AC-3, AC-6(1), AC-6(10), AC-6(2), AC-6(9), CM-11(2), and IA-2; CCI-002110, CCI-000213, CCI-002235, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-001812, and CCI-000764. For MODERATE Impact systems, this subpart (and its subparts) also relate to AC-2 (2), AC-2(3), AC-2(4), AC-6(1), and CM-5(1); CCI-001361, CCI-000017, CCI-000217, CCI-000018, CCI-001403, CCI-001404, CCI-001405, CCI-002130, CCI-001683, CCI-001684, CCI-001685, CCI-001686, CCI-002132, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-001813.}

Any user interface supporting user accounts (either FULLY or MINIMALLY) must limit access according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

All user interfaces FULLY supporting accounts must implement user-based authentication where each account is uniquely assigned to a specific user. User interfaces FULLY supporting accounts must implement at least three (3) levels of user account privilege including: 1) an account with read-only permissions 2) an account with full permissions including account creation and modification and 3) an account with greater permissions than read-only but without account creation and modification.

#### 3.3.1.1 Controllers

For user interfaces provided by controllers, provide access control in accordance with the User Interface Requirements table for the applicable control system and user interface type.

a. For table entries of "NA": NA means Not Applicable, there are no interfaces in this category.

b. For table entries of "None Required": The user interface is not required to support user accounts.

c. For table entries of "MINIMALLY": The user interface must at least MINIMALLY support user accounts.

d. For table entries of "FULLY": The user interface must at FULLY support user accounts.

e. For table entries of "KEY": The user interface must have physical security in the form of either a key lock on the interface itself or be furnished inside a locked enclosure. Where this is required for a read only interface, this lock must prevent viewing of data on the interface; for other interfaces, this lock must prevent using the interface to alter data.

f. For table entries of "Physical Security": For Local FULL interfaces,

the interface must be located inside mission space. For Local Limited (not FULL) interfaces, the user interface must either a) be located within mission space or b) be protected by physical security at least as good as the control devices (and equipment controlled by the control devices) affected by the interface. For purposes of this requirement, 'affected' includes controllers with data that can be directly altered by the interface, as well as mechanical and/or electrical equipment directly controlled by those controllers, but does not include other interactions.

g. Entries of the form "X and Y" must meet both the requirement indicated for X and the requirement indicated for Y. For example, an entry of "MINIMALLY and Physical Security" indicates the user interface must both MINIMALLY support accounts and have physical security.

h. Entries of the form "X or Y" must meet either the requirement indicated for X or the requirement indicated for Y.

3.3.1.1.1 Fire Protection Systems

| User Interface Requirements for MODERATE Impact Fire Protection Systems | |
|---|---|
| **User Interface Type** | **Access Control Requirement** (See note 2) |
| Local Read Only | None Required |
| Local Limited, Non-privileged | None Required |
| Local Limited, Privileged | KEY and Physical Security |
| Local Full | KEY |
| Remote Read Only | None Required |
| Remote Limited, Non-Privileged | FULLY |
| Remote Limited, Privileged AND Remote Full | FULLY |
| Notes:<br>1)Local Read Only User Interfaces are always Non-Privileged<br>2)Devices outside mission space require physical security protections as indicated (in "PHYSICAL SECURITY IN MODERATE IMPACT SYSTEMS") | |

3.3.1.2 Additional User Account Expiration Requirements In MODERATE Impact Systems:

In addition to other user account requirements, user account expiration and auditing must be configured as indicated.

3.3.1.2.1 For Control System Applications Running on Computers

If temporary accounts are supported, expire temporary accounts 72 hours after creation. Expire all other accounts after 35 days of inactivity.

3.3.1.2.2 For Other Control System Devices FULLY Supporting Accounts

If temporary accounts are supported, expire temporary accounts 72 hours after creation. Expire all other accounts after 365 days of inactivity .

3.3.2 Unsuccessful Logon Attempts

{For Government Reference Only: This subpart (and its subparts) relate to 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. If a device cannot meet these requirements, document device capabilities to protect from subsequent logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures in lieu of the indicated requirements without explicit permission from the Government. If no Device Account Lock Exceptions are requested, provide a document stating that no approval is being requested as the Device Account Lock Exception Request.

3.3.2.1 Devices MINIMALLY Supporting Accounts

For MODERATE Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts must lock the user account after five consecutive failed login attempts and must unlock the user account after 60 minutes have elapsed without an unsuccessful login attempt or by a successful login to a separate administrator account.

3.3.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements.

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. If the account being locked is the sole administrator account on the device, the account must stay locked for 1 hour and then automatically unlock.

c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.3.3 System Use Notification

{For Government 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}

3.3.3.1 System Use Notification for Remote User Interfaces

Remote user interfaces must display a warning banner meeting the requirements of DTM 08-060 on screen.

3.3.3.2 System Use Notification for Local User Interfaces

Devices which are connected to a network and have a local user interface must display a warning banner meeting the requirements of DTM 08-060 on the user interface screen if capable of doing so and must have a permanently affixed label with an approved banner from DTM 08-060 if unable to display the warning banner on the screen. Where it is impractical (perhaps due to device size) to affix the label to the device, affix the label to the device enclosure.

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.

3.3.4 Session Lock and Session Termination Requirements In MODERATE Impact Systems:

{For Government Reference Only: This subpart (and its subparts) relates to AC-11(a), AC-11(b), AC-11(1), AC-12, SC-10; AC-10; CCI-000058, CCI-000059, CCI-000056, CCI-000057, CCI-000060, CCI-002360, CCI-002361, CCI-001133, CCI-001134, CCI-000054, CCI-000055, CCI-002252}

3.3.4.1 Session Termination

When session termination is required for a User Interface, the User Interface must implement session termination a) based on manual initiation, or b) based on lack of activity, or c) based on either manual initiation or lack of activity, as indicated.

Session Termination must result in logging out the user. A logged out User Interface may only perform actions as indicated in the "Permitted Actions Without Identification or Authentication" subpart of this Section or display a publicly viewable image or blank screen. User Interfaces must remain logged out (session terminated) until a user enters correct authentication information, which must initiate a new session. All Remote User Interfaces must also terminate network connections as part of session termination.

3.3.4.2 Session Lock

When session lock is required for a User Interface, the User Interface must implement session lock a) based on manual initiation, or b) based on lack of activity, or c) based on either manual initiation or lack of activity, as indicated.

Session lock must result in the User Interface being suspended and the user interface must display a publicly viewable image or blank screen. No interaction with the user interface shall be possible until either a) the same user enters valid authentication information, in which case that session must be continued, or b) until a different user enters valid authentication information at which point the first session must be terminated and a new session initiated for the new user.

3.3.4.3 Session Lock and Termination for Controllers

Writable Remote User Interfaces must support requirements for Session Termination, and must both be capable of being initiated by the user and initiated by lack of activity. Session Termination must initiate after 30 minutes of inactivity.

Local User Interfaces supporting accounts must support manual initiation of Session Termination. Privileged Local User Interfaces must also support timed initiation of Session Termination, unless otherwise indicated in the Session Lock and Termination Exceptions table, with Session Termination initiated at 30 minutes of inactivity. They must also support session lock, where session lock may be initiated by user initiation or automatically after 15 minutes of inactivity.

3.3.5 Permitted Actions Without Identification or Authentication

{For Government 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.

3.3.6 Physical Security in MODERATE Impact Systems

{For Government Reference Only: This subpart relates to PE-3(1), PE-4, PE-5, SC-7(a), SC-7(c), SC-8, SC-8(1); CCI-000928, CCI-002926, CCI-000936, CCI-002930, CCI-002931, CCI-000937, CCI-001097, CCI-001109, CCI-002418, CCI-002419, CCI-002421.}

3.3.6.1 Physical Security for Media

3.3.6.1.1 Physical Security for Media Inside Mission Space

Install all non-IP network media located inside of the mission space in conduit. Install all IP network media located inside of the mission space in intermediate metallic conduit.

3.3.6.1.2 Physical Security for Media Outside Mission Space

Install all network media (both IP and non-IP) located outside of the mission space in rigid metallic conduit.

3.3.6.1.3 Physical Security for Non-Network Media in Fire Protection Systems

For Fire Suppression Systems which can be be inhibited or forced to activate by manipulation of non-network wiring, install all non-network media outside of mission space, including analog and binary instrumentation wiring and power wiring, in rigid metallic conduit.

3.3.6.2 Physical Security for Devices

Install all devices which are located outside of mission space in lockable enclosures. (Recall that per definition of mission space, a room controlled by the mission is mission space regardless of whether it is contiguous with other mission space.)

Install all controllers connected to an IP network in lockable enclosures (both inside and outside of mission space).

3.3.6.2.1 Physical Security for Devices in Fire Protection Systems

For Fire Suppression systems with a release panel, install all components

of the suppression system either inside mission space, or within locked enclosures. Components of these systems include: release panel, any relay or interface panels, analog and binary inputs or outputs, control valves, manual valves.

3.3.6.3 Physical Security for User Interfaces

Physical security requirements for User Interfaces are specified in the preceding paragraphs of this Section.

3.3.7 Enclosures

Prior to final acceptance of the system, lock all lockable enclosures. Submit an Enclosure Keys submittal with all copies of keys for all enclosures and a key inventory list documenting all keys. Label each key with the matching enclosure identifier.

3.4 USER IDENTIFICATION AND AUTHENTICATION

{For Government Reference Only: This subpart (and its subparts) relates to IA-2, IA-2(1),IA-2(12), IA-5 IA-5(b), IA-5(c), IA-5(e), IA-5(g), IA-5(1), IA-5(11); CCI-000764, CCI-000765, CCI-001953, CCI-001954, 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. For MODERATE Impact systems, this subpart also relates to AC-6 (1), AC-6(10), AC-6(2), AC-6(9)IA-2(4), IA-5(13); CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-000768, CCI-002007.}

This subpart indicates requirements for specific methods of identification and authentication for users and user accounts. Where these requirements conflict apply the following order of precedence: 1) If present, Device Specific Requirements take precedence over any other requirements; and then 2) multifactor authentication requirements take precedence over password requirements.

3.4.1 User Identification and Authentication for All System Types

Unless otherwise indicated, all user interfaces supporting accounts (either FULLY or MINIMALLY) must implement Identification and Authorization via passwords.

For MODERATE Impact Systems: Devices with Privileged Remote User Interfaces must implement multifactor authentication via PIV. All other devices and software must not use cached authenticators.

3.4.2 User Identification and Authentication for Specific System Types

System specific requirements are in addition to and supersede those indicated for all system types. When no additional requirements are indicated for a specific system type the requirements for all systems still apply to that system type.

3.4.3 User Identification and Authentication for Specific Devices

There are no additional device specific user interface requirements.

3.4.4 Implementation of Identification and Authorization Requirements

Identification and Authorization must be met by one of the following methods:

a. Direct implementation in the user interface.

b. For remote interfaces: an implementation shared between the remote user interface server and the remote user interface client. For example, a requirement for PIV authentication may be met on a remote user interface by a PIV reader on a web browser client which sends the authentication information via HTTPS to the remote server.

3.4.5 Password-Based Authentication Requirements

3.4.5.1 Passwords for Controllers FULLY Supporting Accounts

All controllers 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. The list of supported special characters must include at least 4 separate characters.

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.

3.4.5.2 Passwords for Remote Interfaces

Passwords for connecting to a Remote User Interface 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. The list of supported special characters must include at least 4 separate characters.

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 (where location is significant, a character may be reused if it is in a different position).

h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.3 Passwords for Devices Minimally Supporting Accounts

Devices MINIMALLY supporting accounts must support passwords with a minimum length of four characters.

3.4.5.4 Password Configuration and Reporting

For all devices with a password, coordinate the changing of passwords with the project site following testing of the system but prior to turnover to the Government. Coordinate with Password Point of Contact to determine appropriate project site personnel to complete password changes. Accompany identified personnel to each device with a password and instruct personnel on the process of changing password. Record the time, date and personnel present when each device's password is changed and submit a Password Change Summary Report documenting this information.

Provide the Password Summary Report electronically in both PDF and Microsoft Excel.

3.4.6 Authenticator Feedback

{For Government 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.

3.5 CYBERSECURITY AUDITING

Where an auditing requirement exists for email notification, notify via email the application administrator and Information System Security Officer (ISSO) of the event. Coordinate with the Email Address Point of Contact for email addresses. If outgoing email is not available to the system, configure the system for these notifications for future support of outgoing email.

3.5.1 Audit Events, Content of Audit Records, and Audit Generation

{For Government Reference Only: This subpart (and its subparts) relates to AU-2(a), AU-2(c), AU-2(d), AU-3, AU-10, AU-12, AU-13(3), AU-14(b), AU-14(1), AU-14(2), AU-14(3), CM-5(1), SC-7 (9); CCI-000123, CCI-001571, CCI-000125, CCI-001485, CCI-000130, CCI-000131, CCI-000132, CCI-00133, CCI-000134, CCI-001487, CCI-000166, CCI-001899, CCI-000169, CCI-001459, CCI-000171, CCI-000172, CCI-001910, CCI-001914, CCI-001919, CCI-001464, CCI-001462, CCI-001920, CCI-001814, CCI-002400. For MODERATE Impact

systems, this subpart (and its subparts) also relates to AU-3 (1); CCI-000135, CCI-001488}

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.

If auditing requirements can be met using existing control system alarm or event capabilities, those existing capabilities may be used to meet these requirements.

3.5.1.1 Default Requirements for Control System Controllers

For control system controllers where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

3.5.1.1.1 Controllers Which FULLY Support Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.1.1.1 Audited Events

Configure each controller 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. Successful logouts

d. Concurrent logons from different workstations

e. All account creations, modifications, disabling, and terminations. For MODERATE Impact Systems, also provide email notification when these audit events occur.

f. All kernel module load, unload, and restart

g. For privileged user interfaces in MODERATE Impact Systems: All user commands.

3.5.1.1.1.2 Audit Event Information To Record

Configure each controller 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

g. For privileged user interfaces in MODERATE Impact Systems: Full text recording of the executed command and the user executing the command.

For MODERATE Impact Systems: Audit records must provide sufficient detail to reconstruct events to determine cause of compromise and magnitude of damage, malfunction, or security violation

3.5.1.1.2 Controllers Which Do Not FULLY Support Accounts

For each controller which does not FULLY support accounts configure the controller to audit all controller shutdown and startup events and to record for each event the type of event and when the event occurred.

3.5.2 Audit Time Stamps

{For Government Reference Only: This subpart (and its subparts) relates to AU-8; CCI-000159, CCI-001889, CCI-001890. For MODERATE Impact systems, this subpart (and its subparts) also relates to AU-8 (1); CCI-001891, CCI-001892, CCI-002046.}

Any device (computer or controller) generating audit records must have an internal clock capable of providing time with a resolution of one second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device (computer or controller) generating audit records maintains accurate time to within 1 second. Note that if the control system specifications include requirement for clocks, the most stringent requirement applies.

3.5.3 Auditing Front End Software

The project site currently has the following software to support control system auditing: none. If there is no existing auditing front end software or the software is not compatible with the provided control systems, provide Auditing Front End Software with audit log import and upload, export, notification, and analysis functionality. The Auditing Front End Software may be provided as a component of the control system front end or as a separate software package, and a single package may serve multiple control systems provided under the same projects if they are sharing a cybersecurity authorization.

When the Auditing Front End Software is neither existing nor installed under the requirements of another Section, furnish the Auditing Front End Software media and license for subsequent Government installation. Submit copies of Auditing Front End Software if this function is not part of the software provided with the control system to meet requirements of other Sections.

3.5.3.1 Import and Upload Requirements

Auditing Front End Software must be capable of importing audit logs from the Device Audit Record Upload Software and of uploading audit logs over the network from all control system devices supporting network upload of audit logs.

3.5.3.2 Export Requirements

Auditing Front End Software must be capable of exporting to a file format supported by Microsoft Excel.

3.5.3.3 Notification Of Audit Failure in Devices in MODERATE Impact Systems

The auditing front end software must be capable of receiving notifications of audit failure from control system devices and computers and be able to provide email notification based on receipt of the notification.

3.5.3.4 Audit Reduction and Report Generation In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relates to AU-6(4), AU-7(a), AU-7(b), AU-7(1), AU-12(1); CCI-000154, CCI-001875, CCI-001876, CCI-001877, CCI-001878, CCI-001879, CCI-001880, CCI-001881, CCI-001882, CCI-000158, CCI-000173, CCI-000174, CCI-001577.}

Auditing Front End Software must provide audit reduction and reporting capabilities that supports on-demand review and analysis, on demand reporting, and after the fact investigations of security incidents. The software must be able to combine audit records from all components within the system and analyze them as a single audit record. The software must correct for discrepancies in timestamps of audit logs from different sources and be able to account for discrepancies up to 2 seconds between sources. The software must not alter original audit record content or time ordering of audit records. The software must have the capability to filter audit records using user-defined fields within the audit records.

The audit reduction and reporting capabilities may incorporate third party application, such as Excel or Access.

3.5.4 Audit Storage Capacity and Audit Upload

{For Government Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

The creation of audit records must never interfere with normal device operation. Devices must cease collection of auditing information if required to maintain normal operation.

a. For controllers capable of generating audit records, provide 60 days worth of secure local storage, assuming 10 auditable events per day.

3.5.4.1 Audit Log Storage Notification In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relates to AU-5(1); CCI-001855.}

Controllers storing audit logs must provide notification when audit logs reach 75 percent of capacity either directly through email or indirectly by sending a notification to a computer, and the computer sending an email. Computers storing audit logs must provide notification when audit logs reach 75 percent of capacity directly through email.

3.5.4.2 Device Audit Record Upload Software

For each device (computer or controller) required to audit events and for which audit logs cannot be uploaded over the network by the Auditing Front

End Software, provide and license to the Government software implementing a secure mechanism of uploading audit records from the device and exporting them to the Auditing Front End Software. 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 this function is not part of the software provided with the control system to meet requirements of other Sections. If there are no devices requiring this software, provide a document stating this in lieu of this submittal.

3.5.5 Response to Audit Processing Failures

{For Government Reference Only: This subpart (and its subparts) relates to AU-5; CCI-000139, CCI-000140, CCI-001490.}

In case of an audit failure, if possible, continue to collect audit records by overwriting existing audit records.

For MODERATE Impact Systems: In the case of an audit failure at a controller performing auditing, the device must notify the associated auditing front end software of the audit failure if able, and must continue to collect audit records by overwriting existing audit records if able. The auditing front end software must provide notification as indicated, treating the notification of failure from the device as a failure in the auditing system.

3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Government Reference Only: This subpart (and its subparts), along with the network communication report submittal specified elsewhere in this section, relates to CM-6(a), CM-6(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 MODERATE Impact systems, this subpart (and its subparts) also relates to CM-7(2), CM-7(5)(a), CM-7(5)(b); CCI-000381, CCI-000380, CCI-00382, CCI-001761, CCI-001762}

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.

3.6.1 Device Capabilities

Do not provide devices with remote user interfaces or full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

Unless specifically required by the government, do not provide a capability to update device firmware over the network.

3.6.2 Software

For software that has a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port access for least functionality), install and configure the software in accordance with that STIG or SRG.

For MODERATE Impact Systems: Do not provide (install) software that is not specifically required to meet a contract requirement. Do not implement functionality within softwarethat is not specifically required to meet contract requirements.

## 3.7 SYSTEM AND COMMUNICATION PROTECTION

### 3.7.1 Collaborative Computing

{For Government Reference Only: This subpart relates to SC-15(a), SC-15(b); CCI-001150, CCI-001152.}

Without explicit approval from the project site, control systems must not use collaborative computing technologies.

### 3.7.2 Denial of Service Protection and Application Partitioning In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-5, SC-39, SC-7(a); CCI-001093, CCI-002385, CCI-002386, CCI-002430, CCI-001097. For MODERATE Impact systems, this subpart also relates to SC-2; CCI-001082.}

To the greatest extent practical, implement control logic without reliance on the network. Except when required to meet the requirements of the control system Section (where the requirement can only be met using computer hardware), do not implement control logic in computers. For MODERATE Impact systems, do not implement control logic in a device providing (i.e. acting as a server for) a Full Remote User Interface.

#### 3.7.2.1 Default Requirements for MODERATE Impact Control Systems

Except for networked input and outputs on input-output buses specifically designed to provide high reliability or redundancy, sensors and actuators must not rely on the network to exchange data with the controller executing the sequence of operation which uses the sensor value or determines the actuator command.

Sensor values required by multiple devices may be shared over the network provided they are connected to a controller requiring the value for execution of the sequence and that controller shares the value on the network.

### 3.7.3 Process Isolation and Boundary Protection in Moderate Impact Fire Protection Systems

{For Government Reference Only: This subpart relates to SC-7(a), SC-7(c), SC-7(4)(a), SC-7(4)(c), SC-7(5), SC-7(7), SC-7(9)(a), SC-7(11), SC-7(13), SC-7(13), SC-7(18); CCI-001097, CCI-001098, CCI-001102, CCI-002396, CCI-001109, CCI-002397, CCI-002398, CCI-002399, CCI-002403, CCI-001120, CCI-001119, CCI-001126}

#### 3.7.3.1 Radio Interfaces for Fire Protection Systems

When radios interfacing a local fire protection system to a supervisory system are not NIST FIPS 140-2 validated, use a relay panel interface between the local fire protection system and the radio. Install and configure the relay panel to prohibit initiating any action within the local fire protection system other than causing the system to play a pre-recorded message or causing the system to play a live audio message.

Install relays using the normally closed contact such that they pass a signal when they open, and so that a relay that loses power or has a failed coil passes the signal

3.8 SAFE MODE AND FAIL SAFE OPERATION

{For Government Reference Only: This subpart (and its subparts) relates to CP-12, SI-10(3), SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002754, 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.

3.9 SYSTEM MAINTENANCE TOOL SOFTWARE

{For Government Reference Only: This subpart (and its subparts) relates to MA-3; CCI-000865.}

Submit and license to the Government all software required to operate, maintain and modify the control system such 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. Submit hard copies of user manuals for each software with the software submittal.

For software provided and licensed to the Government under the requirements of another Section, submit a statement indicating the Section and Submittal under which the software was provided. For software provided to meet the requirements of this Section and not provided and licensed under another Section, submit software and software user manuals on DVD or CD as a Technical Data Package and submit two hard copies of the software user manual for each piece of software.

3.10 DEVICE POWER

{For Government Reference Only: This subpart (and its subparts) relates to PE-11, PE-11(1); CCI-002955, CCI-000961. For MODERATE Impact systems, this subpart (and its subparts) also relates to PE-9, PE-9(1); CCI-000952, CCI-002953, CCI-002954.}

For MODERATE Impact Systems: Provide control system with power supply meeting or exceeding the reliability of the controlled equipment. Powering control system devices using the same power source as the equipment controlled by the device is a permissible method of meeting this requirement. Without explicit approval from the government, do not install local uninterruptible power supplies (UPSs) as a source of device power.

3.10.1 Device Behavior on Loss of Power In MODERATE Impact Systems:

Application programs and configuration settings must be stored in devices in manner such that a loss of power does not result in a loss of the application program or configuration settings: Loss of power must never result in the loss of application programs, regardless of the length of time power is lost; and loss of power for less than 2,500 hours must not result in the loss of configured settings.

In the event of a loss of power, when power is restored, controllers and computers executing control logic (and the underlying equipment) must recover and resume their normal sequences of operation. Note that the

sequence of operation may require specific actions (e.g. startup sequences) upon recovery from loss of power.

## 3.11 VULNERABILITY SCANNING

{For Government Reference Only: This subpart (and its subparts) relates to RA-5 RA-5(a),RA-5(b),RA-5(c),RA-5(d); CCI-001054, CCI-001055, CCI-000156, CCI-001641, CCI-001643, CCI-001057, CCI-001058, CCI-001059. For MODERATE Impact systems, this subpart (and its subparts) also relates to RA-5(1), RA-5(5); CCI-001062, CCI-001067, CCI-001645, CCI-002906.}

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.

### 3.11.1 Controllers

Controllers shall be scannable by standard control system discovery tools or control system browsers and return meaningful status information including the network inputs and outputs for the controller. This information shall contain sufficient detail to detect vulnerabilities or exploits of the controller.

Provide all software needed to scan the control system as the Control System Scanning Tools submittal. If the software required to scan the system is already installed at the project site or is provided under a separate section instead provide a statement indicating this.

## 3.12 SYSTEM AND INTEGRATION INTEGRITY

### 3.12.1 Software, Firmware, and Information Integrity In MODERATE Impact Systems:

If there exists Integrity Verification Software that can check software, firmware, or information in the control system and verify its integrity, provide it. If no such software exists provide a statement to this affect in lieu of the software.

## 3.13 CONTROL SYSTEM CYBERSECURITY TESTING

{For Government Reference Only: For MODERATE Impact systems, this subpart (and its subparts) relates to SA-11(a), SA-11(b), SA-11(c), SA-11(d), SA-11(e); CCI-003171, CCI-003172, CCI-003173, CCI-003174, CCI-003175, CCI-003176, CCI-003177, CCI-003178.}

### 3.13.1 Control System Cybersecurity Testing Procedures

Prepare Control System Cybersecurity Testing Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system meets the requirements of this Section.

Submit 4 copies of the Control System Cybersecurity Testing Procedures. The Control System Cybersecurity Testing Procedures may be submitted as a Technical Data Package.

### 3.13.2 Control System Cybersecurity Testing Execution

Using the Control System Cybersecurity Testing Procedures verify that the control system meets the requirements of this Section. UNLESS GOVERNMENT

WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. If testing reveals deficiencies in the system, correct the deficiency and retest until successful.

3.13.3 Control System Cybersecurity Testing Report

Prepare and submit a Control System Cybersecurity Testing Report documenting all tests performed and their results. Include all tests in the Control System Cybersecurity Testing Procedures and any additional tests performed during testing. Document test failures and repairs conducted with the test results.

Submit four copies of the Control System Cybersecurity Testing Report. The Control System Cybersecurity Testing Report may be submitted as a Technical Data Package.

3.14 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT

In addition to testing and testing support required by other Sections, provide a minimum of 16 hours of technical support for cybersecurity testing of control systems to support the DoD Risk Management Framework process Cybersecurity assessment of the control system. This support is independent of (and in addition to) the Control System Cybersecurity Testing specified in this section.

3.15 CYBERSECURITY TRAINING

Provide eight hours of classroom and hands-on training for six Government personnel on the cybersecurity operation and maintenance of the control system provided. This training is in addition to and must be coordinated with control system training specified in other Sections.

The Government will provide the training location. Training must cover, at a minimum: (a) applying software and firmware updates, (b) user account creation, modification and deletion, (c) audit log upload procedures and (d) identification of privileged user interfaces and system impact of those interfaces. Training session must include a question and answer period during which government staff questions about cybersecurity aspects of the control system are answered.

-- End of Section --

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SECTION 25 05 11.23

CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS
ENERGY MANAGEMENT AND CONTROL SYSTEM
**05/21**

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 https://public.cyber.mil/stigs/downloads/ and an SRG/STIG Applicability Guide and Collection Tool is available at https://public.cyber.mil/stigs/SCAP/. Not all control system components have applicable STIGs or SRGs. The "Control Systems SRG" does not apply to work performed under this Section; all requirements within this section to apply applicable SRGs DO NOT include the "Control Systems SRG".

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: Energy Management And Control System, including HVAC, Advanced Metering, and Building Lighting Control.

1.2 RELATED REQUIREMENTS

This section does not contain sufficient requirements to procure a control system and must be used in conjunction with other Sections which specify control systems. This Section adds cybersecurity requirements to the control systems specified in other Sections, to include without constraint Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS, 26 51 00 INTERIOR LIGHTING, and Section 26 27 13.10 30 ELECTRIC METERS, and as these requirements are conditioned on the control system being provided, there may be requirements in this Section that will not apply to this project. 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.

In cases where a requirement is specified in both this Section and in another Section, the more stringent requirement must be met. In cases where a requirement in this Section conflicts with the requirements of another Section such that both requirements cannot be met at the same time, request direction from the Contracting Officer Representative to determine which requirement applies to the project.

## 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 |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE 802.1x | (2010) Local and Metropolitan Area Networks - Port Based Network Access Control |

INTERNET ENGINEERING TASK FORCE (IETF)

| | |
|---|---|
| IETF RFC 2819 | (2000) Remote Network Monitoring (RMON) Management Information Base (MIB) |

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

| | |
|---|---|
| NIST FIPS 140-2 | (2001) Security Requirements for Cryptographic Modules |
| NIST FIPS 201-2 | (2013) Personal Identity Verification (PIV) of Federal Employees and Contractors |

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 Administrator Account

An administrator account is an account with full permissions to a device, application, or operating system, including the ability to create and modify other user accounts.

Note that the operating system Administrator Account may be different than Administrator Accounts for applications hosted on that operating system. Also, most controllers will not have any support for accounts and will therefore not have an 'Administrator Account'.

### 1.4.2 Computer

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 Operating System, where Android is considered separate from Linux

e. a device running a version of Apple iOS

Unless otherwise indicated or clear from context use of the word "device" in this Section includes computers.

1.4.3 Controller

A device other than a computer or Ethernet switch.

1.4.4 Mission Space

A device or media is in mission space if physical access to the device or media is controlled by the organization served by the device. For example, a VAV box controller in a suspended ceiling is in mission space if the VAV box serves that room; an electrical switchgear in an electrical room or an AHU in a mechanical room or on a rooftop may still be considered to be in mission space if the organization (mission) served by that switchgear or AHU controls access to the electrical room, mechanical room or rooftop.

1.4.5 Network

A network is a group of two or more devices that can communicate using a network protocol. Network protocols must provide a method for addressing devices on the network; a communication method that does not provide an addressing scheme is not a networked form of communication. Devices that communicate using a method of communication that does not support device addressing are not using a network.

1.4.6 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 (unlike many IT definitions of "Network Connected") 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).

1.4.6.1 Wireless Network Connected

Any device that supports wireless network communication is network connected to a wireless network, regardless of whether the device is communicating using wireless. Unless physically disabled, devices with wireless transceivers support wireless, it is not sufficient to disable the wireless in software.

1.4.7 Network Media

The thing that provides the communication channel between the devices on a network. Typically wire, but might include wireless, fiber optic, or even power line (some network protocols allow sending network signals over power wiring).

1.4.8 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

1.4.8.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts. These devices support user-based (as opposed to role-based) authentication.

1.4.8.2 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 "username and password" structure). These devices typically only support role-based authentication.

Examples of devices which MINIMALLY support accounts are a) a variable frequency drive with a single account which requires a PIN for access to configuration; and b) a room lighting control touchpad interface that has a single account.

1.4.8.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.9 Manual Local Input

Manual Local Inputs are system analog or binary inputs that are adjustable by a person but are, by intrinsic hardware design, very limited in potential capabilities. Manual Local Inputs do not have touch screens or full keyboards, but may have a few buttons or dials to allow input. Manual Local Inputs do not have full graphic screens or dot-matrix displays, but may have simple lights (LEDs) or 7-segment displays. Manual Local Inputs do not have any sort of menu structure, each button has a single well-defined function.

Examples of Manual Local Inputs are H-O-A switches, simple thermostats, and disconnect switches.

1.4.10 Card Reader

A card reader is an input/output device whose primary function is to assist in two-factor authentication. A card reader must have an interface to read data from a card and may be able to write data to a card. A card reader may have a means (such as buttons, keypad, touchscreen, etc.) for a user to input a PIN or password, as well as a limited display.

### 1.4.11 User Interface

A User Interface (UI) is something other than a Manual Local Input or Card Reader that allows a person to interact with the system or device. Note that while a Card Reader is not by itself a User Interface, a User Interface may contain a Card Reader in order for it to authenticate its user. Within control systems, there are a wide range of User Interfaces.

Two important distinctions are 1) whether the user interface is Local or Remote, and 2) the effective capabilities of the User Interface to alter data, which is the "privilege" of the user interface (where effective privilege available to a specific user at a specific user interface is the combination of the greatest privilege offered by the user interface and the specific account the user is logged into).

#### 1.4.11.1 Local User Interface

A Local User Interface is a user interface where the physical hardware the user interacts with (keyboard, buttons, display, etc.) is physically part of the device being affected. All of the relevant characteristics of the user interface are embodied within a single device.

Note that a Local UI may be able to access data in a different device, Local versus Remote in this context refers to the user interface itself; the capability to access data in a different device is covered under "Full User Interface".

#### 1.4.11.2 Remote User Interface

A Remote User Interface implements a Client/Server model where the physical hardware the user interacts with (Client) is physically distinct from the device being affected (Server). Most or all of the security and functionality characteristics of the user interface are defined by the Server, not the Client. The Client and Server communicate via a network connection. A common example of a remote user interface is a web-based interface where the browser (client) is generally on different hardware than the web server (server). A Remote UI remains a Remote UI even if the user happens to be at a Client on the same hardware as the Server. What is important is that a) the Client may be on different hardware than the Server and b) the majority of the security and functional characteristics of the interface are defined at the Server.

Note that this definition of "remote" is consistent with that generally used in the control industry but is not aligned with the NIST 800-53 definition of "Remote", which refers to "outside the system". The term "Remote" here better aligns with the NIST 800-53 definition of "Network" (remote from within the system) Access.

#### 1.4.11.3 Types of User Interface (by capability)

User interfaces are also categorized by their capabilities as being Read Only, Limited, or Full.

##### 1.4.11.3.1 Read-Only User Interface

A Read Only User Interface (also referred to as a View-Only User Interface) is a user interface that only allows for reading data, it does not allow (have the capability to) modify data. A Read Only User

Interface may be either Local or Remote. A User Interface that is configured to be Read Only (by some other means than the interface itself, such as using configuration software on a laptop) is a Read-Only Interface. Note a Read Only User Interface may have buttons (or touch screen, etc.) allowing the user to navigate through the presentation of data.

Examples of a Read Only User Interfaces are a) a publicly viewable "energy dashboard" showing weather data and energy usage within a building and b) digital wayfinding signage.

1.4.11.3.2 Limited User Interface

A Limited User Interface is a user interface that - by design - can only alter information local to the user interface. Note that the determination of "alter" includes only direct interactions, it explicitly excludes interactions that might occur as secondary effects. For example, an interface changing the flow setpoint in a pump controller is a direct interaction, the subsequent change in flow (as well as any subsequent downstream changes in valve position) are not direct interactions.

Two examples of LIMITED UIs are: a) a variable speed drive has a Limited Local User Interface which allows the user to change properties within the drive, but does not allow affecting things outside the drive; and b) a typical home WiFi Router has a Limited Remote User Interface which allows configuration of the Router, but does not allow direct interaction with other devices.

1.4.11.3.3 Full User Interface

A Full User Interface can alter information in devices outside the device with the user interface. For example, a typical Local Display Panel is a Full Local User Interface while a browser-based front end is a Full Remote User Interface.

1.4.11.3.4 View-Only User Interface

See Read-Only User Interface

1.4.11.4 Other User Interface Terminology

In addition to defining whether a user interface is a Hardware Limited, Read-Only, Limited or Full, and whether it is Local or Remote, user interfaces are classified by whether they are writable or privileged.

1.4.11.4.1 Writable User Interface

Any User Interface that is not Read-Only is Writable. (Limited User Interfaces and Full User Interfaces are both writable user interfaces (as they are capable of changing a value)).

1.4.11.4.2 Privileged User Interface

A Privileged UI is a UI that has sufficient capabilities or functionality that it requires specific cybersecurity measures to be put in place to limit its unauthorized use. Ultimately, whether a specific user interface is considered a Privileged User Interface must be determined by usage. Unless otherwise specified, user interfaces can be determined to be privileged or not using the following:

a. Read-Only User Interfaces are not privileged user interfaces.

b. Full User Interfaces are privileged user interfaces.

c. User interfaces that allow for configuration of auditing or allows for modification or deletion of audit logs are privileged user interface.

d. User interfaces that allow for reprogramming a network connected device is a privileged user interface.

e. Except as specified above, a Limited User Interface must be determined to be privileged or not based on the specific capabilities and use case of the user interface. In general however, user interfaces that do not offer significant capabilities above and beyond those available at that location via other means (e.g. such as a disconnect switch, breaker, or hand-off-auto switch, or physical attack) are not privileged.

1.4.12 Wireless Network

Any network that communicates without using wires or fiber optics as the communication media. Wireless networks include: WiFi, Bluetooth, ZigBee, cellular, satellite, 900 MHz radio, 2.4 GHz, free space optical, point-to-point laser, and IR.

1.4.13 Wired Broadcast Network

Wired Broadcast Networks are any network, such as powerline carrier networks and modem (wired telephony), that use wire-based technologies where there is not a clearly defined boundary for signal propagation.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Points of Contact

Coordinate with the following Points of Contact as indicated in this Section and as required. Not all projects will require coordination with all Points of Contact. When coordination is required and no Point of Contact is indicated, coordinate with The Contracting Office Representative (COR).

a. Government Computer Access Point of Contact: The Contracting Office Representative (COR)

b. HTTPS Certificate Point of Contact: The Contracting Office Representative (COR)

c. Email Address Point of Contact: The Contracting Office Representative (COR)

d. Password Point of Contact: The Contracting Office Representative (COR)

e. Mobile Code Point of Contact: The Contracting Office Representative (COR)

f. PKI Infrastructure Point of Contact: The Contracting Office Representative (COR)

g. Energy Management Point of Contact: 28 CES/CEOIC Representative - Clint Peterson

1.5.2 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 alternate account lock permissions, the Device Account Lock Exception Request must be approved prior to control system device selection and installation.

b. If requesting permission for the use of a device with multiple physical connections to IP networks, the Multiple IP Connection Device Request must be approved prior to control system device selection and installation.

c. 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.

d. The Cybersecurity Interconnection Schedule must be coordinated with other work that will be interconnected to, and interconnections must be approved by the Government before relying on them for system functionality.

e. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.

f. Passwords must be coordinated with the indicated contact for the project site.

g. If applicable, HTTPS web server certificates must be obtained from the indicated HTTPS Certificate Point of Contact.

h. Contractor Computer Cybersecurity Compliance Statements must be provided for each contractor using contractor owned computers.

i. Installation of metering instrumentation must meet cybersecurity requirements in accordance with the Air Force Meter Data Management Plan (MDMP) and AMRS Meter Specification.

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-01 Preconstruction Submittals

Device Account Lock Exception Request; G-RO

Multiple Ethernet Connection Device Request; G-RO

Contractor Computer Cybersecurity Compliance Statements; G-RO

Contractor Temporary Network Cybersecurity Compliance Statements; G -RO

Cybersecurity Interconnection Schedule; G-RO

Cybersecurity Subject Matter Expert Qualifications; G-RO

Proposed STIG and SRG Applicability Report; G-AE

SD-02 Shop Drawings

Network Communication Report; G-AE

Cybersecurity Riser Diagram; G-AE

SD-03 Product Data

Control System Cybersecurity Documentation; G-AE

SD-06 Test Reports

Control System Cybersecurity Testing Procedures; G-RO

Control System Cybersecurity Testing Report; G-RO

SD-07 Certificates

Software Licenses; G-RO

SD-11 Closeout Submittals

Password Change Summary Report; G-RO

Enclosure Keys; G-RO

Software and Configuration Backups; G-RO

Auditing Front End Software; G-RO

Device Audit Record Upload Software; G-RO

System Maintenance Tool Software; G-RO

Control System Scanning Tools; G-RO

STIG, SRG and Vendor Guide Compliance Result Report; G-RO

Control System Inventory Report; G-AE

## 1.7 QUALITY CONTROL

### 1.7.1 Qualifications

For the positions listed below resumes should be submitted to the Government within 14 days after notice to proceed. All certifications must be in effect prior to being hired.These positions may serve across the contract.

1.7.2 Cybersecurity Subject Matter Expert Qualifications

The individual selected will oversee all work within this specification. This position requires that the individual currently possess professional qualifications consistent with Information Assurance Manager Level II and Information Assurance Technical Level II per DoD 8570.01-M, Information Workforce Improvement Program, and DoD 8140.01, Cyberspace Workforce Management. The individual will function in a system administrator role as required in support of cybersecurity activities outlined in this Section.

1.8 CYBERSECURITY DOCUMENTATION

{For Government Reference Only: This subpart (and its subparts) relates to PL-7; CCI-003071}

1.8.1 Proposed STIG and SRG Applicability Report

For each model of network connected or network infrastructure device, use the DISA SRG/STIG Applicability Guide and Collection Tool (available at https://public.cyber.mil/stigs/SCAP/to identify applicable STIGs or SRGs and provide a report indicating applicable STIGs and SRGs for each model.

1.8.2 Cybersecurity Interconnection Schedule

{For Government Reference Only: This subpart relates to CA-3(b), PL-8, SC-7(9), SC-7(11); CCI-000258, CCI-003072, CCI-003073, CCI-003075, CCI-002398, CCI-002399, CCI-002401, CCI-002402, CCI-002403.}

Provide a completed Cybersecurity Interconnection Schedule documenting network connections between the installed system and other systems. Provide the following information for each device directly communicating between systems: Device Identifier, Device Description, Transport layer Protocol, Network Address, Port (if applicable), MAC (Layer 2) address (if applicable), Media, Application Protocol, Service (if applicable), Descriptive Purpose of communication. For communication with other authorized systems also provide the Foreign Destination and POC for Destination. 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 Cybersecurity Interconnection Schedule as an editable Microsoft Excel file (a template Cybersecurity Interconnection Schedule in Excel format is available at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1

1.8.3 Network Communication Report

{For Government Reference Only: This subpart (and its subparts) relates to CA-9, PL-8; CCI-003075; CCI-002102, CCI-002103, CCI-002104, CCI-002105, CCI-003072, CCI-003073, CCI-003075 and also the submittal requirements associated with CM-6, CM-7, SC-8 and SC-41 including CM-7(3), CCI-000388.}

Provide a network communication report. For each networked device, document the communication characteristics of the device including communication protocols, services used, encryption employed, and a general description of what information is communicated over the network. For each device using IP, document all TCP and UDP ports used. For non-IP

communications, document communication protocol and media 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.

1.8.4 Control System Inventory Report

{For Government Reference Only: This subpart (and its subparts) relates to CM-8(a), SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, 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 https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 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.

1.8.5 Software and Configuration Backups

{For Government Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each computer and control system device on which software is installed or a configuration file is modified under this project, provide a recovery image of the final as-built computer and device. 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. If additional user permissions are required to meet this requirement, coordinate the creation of the image with the identified Government Computer Access Point of Contact.

For all ethernet switches provide a backup of the switch configuration. For all controllers, provide a backup of the controller configuration and the source code for all loaded application programs (all software that is not common to every controller of the same manufacturer and model).

If any or all of these are provided under another Section, provide documentation indicating this and referencing those submittals.

1.8.6 Cybersecurity Riser Diagram

{For Government Reference Only: This subpart (and its subparts) relates to PL-2(a), PL-8; CCI-003051, CCI-003053, CCI-003072, CCI-003073, CCI-003075}

Provide a cybersecurity riser diagram of the complete control system including all network and device 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.

1.8.7 STIG, SRG and Vendor Guide Compliance Result Report

For every component (device or software) with an applicable STIG or SRG in the Proposed STIG and SRG Applicability Report, provide a result report documenting compliance with the STIG or SRG requirements. For components which are scannable by the SCAP (security content automation protocol) tool (available online at https://public.cyber.mil/stigs/scap), provide the SCAP report and raw scan results.

For every component (device or software) with manufacturer provided cybersecurity documentation, procedure, or method for secure configuration or installation, provide a report documenting how the component was configured and any deviation from the manufacturer instructions.

1.8.8 Control System Cybersecurity Documentation

{For Government Reference Only: 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.

1.8.8.1 Software Applications

For all software applications running on computers provide:

a. administrator documentation that describes secure configuration of the software {For Government Reference Only: relates to CCI-003124}

b. administrator documentation that describes secure installation of the software {For Government Reference Only: relates to CCI-003125}

c. administrator documentation that describes secure operation of the software {For Government Reference Only: relates to CCI-003124}

d. administrator documentation that describes effective use and maintenance of security functions or mechanisms for the software {For Government Reference Only: relates to CCI-003127}

e. administrator documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the software {For Government Reference Only: 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 {For Government Reference Only: 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 {For Government Reference Only: relates to CCI-003130}

h. user documentation that describes user responsibilities in maintaining

the security of the software {For Government Reference Only: relates to CCI-003131}

1.8.8.2 For HVAC Control System Devices

1.8.8.2.1 HVAC Control System Devices FULLY Supporting User Accounts

For all HVAC Control System Devices which FULLY support user accounts, provide:

a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}

b. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}

c. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government 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 Government 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 Government 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 Government Reference Only: relates to CCI-003130}

1.8.8.2.2 All Other HVAC Control System Devices

For all HVAC 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 Government 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 Government 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 Government Reference Only: relates to CCI-003130}

1.8.8.3 For Lighting Control System Devices

1.8.8.3.1 Lighting Control System Devices FULLY Supporting User Accounts

For all Lighting Control System Devices which FULLY support user accounts, provide:

a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}

b. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}

c. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government 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 Government 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 Government 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 Government Reference Only: relates to CCI-003130}

1.8.8.3.2 All Other Lighting Control System Devices

For all Lighting 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 Government 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 Government 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 Government Reference Only: relates to CCI-003130}

1.8.8.4 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 Government Reference Only: relates to CCI-003124}

b. Documentation that describes secure installation of the device {For Government Reference Only: relates to CCI-003125}

c. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}

d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government 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 Government 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 Government 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 Government Reference Only: relates to CCI-003130}

h. Documentation that describes user responsibilities in maintaining the security of the device {For Government Reference Only: relates to CCI-003131}

## 1.9 SOFTWARE LICENSING

{For Government Reference Only: This subpart (and its subparts) relates to SI-2(a), SI-2(c), SI-7(14); CCI-001227, CCI-002605, CCI-002737}

For all software provided that has not already been licensed to the government or project site, provide a license to the Government for a period of no less than 5 years, and the license must also include the following software updates:

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

## 1.10 CYBERSECURITY DURING CONSTRUCTION

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, SA-3; CCI-000258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

### 1.10.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. Contractor computers connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.1.1 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.

1.10.1.2 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. Computers used on this project must be scanned using the installed software at least once per day.

1.10.1.3 Passwords and Passphrases

The passwords and passphrases for computers, applications, and web-based applications supporting passwords 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.

1.10.1.4 User-Based Authentication

Each user must have a unique account; sharing of a single account between multiple users is prohibited.

1.10.1.5 Demonstration of Compliance

The Government has the right to require demonstration of computer compliance with these requirements at any time during the project.

1.10.1.6 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 https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 Each Statement must be signed by a cybersecurity representative for the relevant company.

1.10.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than those specifically provided or furnished for this project. Any and all access to the network from outside the project site is prohibited.

1.10.3 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.

1.10.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks, when permitted, must not interfere with existing wireless networks, must use WPA2 security and must not broadcast the network name (SSID). Network names (SSID) for wireless networks must be changed from their default values.

1.10.5 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.

1.10.6 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 https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 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.

1.11 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

All products used on this project must meet the indicated requirements, but not all products specified here will be required by every project.

2.1 ETHERNET SWITCH

Provide Open Systems Interconnection (OSI) Layer 2 Ethernet switches with the following capabilities, and with an interface to support switch configuration for these capabilities:

2.1.1 Required Functionality

Switches must:

a. Copper Ethernet ports must auto negotiate for 10, 100 and 1000 megabits-per-second links.

b. Be capable of implementing port level access control by MAC address and limit the number of MAC addresses to one MAC address per port.

c. For LOW Impact Systems, be capable of implementing per-port access control lists (ACLs) where the list can be filtered by source and destination IP addresses, and by source and destination UDP or TCP ports.

d. Support Remote Network Monitoring (RMON) Port Analysis in accordance with IETF RFC 2819

e. Configure target port and analysis port such that switch clones all target port traffic to analysis port.

f. Support authentication via RADIUS server (for management and 802.1x)

g. Support IEEE 802.1x network login.

2.1.2 Configuration Requirements

Switches must:

a. Support configuration save and restore.

b. Support both manual IP address assignment and acquisition of a dynamic IP address via Dynamic Host Configuration Protocol (DHCP).

c. Be capable of limiting access for configuration to one or more of: a web interface using HTTPS, a command line interface using SSH, or an SNMP connection using SNMP version 3 or later.

d. Support the ability to lock configuration capability to a dedicated management port.

2.2 DAISY CHAIN IP CONTROLLERS

Controllers used as Daisy Chain IP Controllers must be IP controllers with exactly two Ethernet network connections and basic built-in switch capabilities to allow implementation of an Ethernet network in a daisy chain architecture. Switches incorporated by Daisy Chain IP Controllers are not required to meet the requirements for Ethernet Switches as defined in this Section.

PART 3 EXECUTION

3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES

Install, configure, and harden all hardware and software furnished on this project in accordance with manufacturer provided documentation, procedures, or methods for secure configuration or installation. Do not implement specific hardening actions if that action would conflict with required functionality or another requirement of this Section.

3.2 NETWORK REQUIREMENTS

3.2.1 Wireless and Wired Broadcast Communication

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, AC-18(3); CCI-001438, CCI-001439, CCI-002323, CCI-001441, CCI-002252}

Unless explicitly authorized by the Government, do not use any wireless or

wired broadcast communication. If requesting authorization for wireless or wired broadcast communication, wired broadcast media such as powerline carrier is preferred to wireless.

3.2.2 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.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.2.3 IP Control Networks

{For Government Reference Only: This subpart relates to CM-6(a), CM-7(a), CM-7(b), CM-7(1)(b), SC-41; CCI-001588, CCI-000381, CCI-000380, CCI-000381, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546.}

IP Networks must be Ethernet networks and must use switches which are Ethernet Switches or Daisy Chain IP Controllers as defined in this Section. 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.

3.2.3.1 IP Network Routers

Do not install any device that performs IP routing.

3.2.3.2 IP Devices With Multiple Ethernet Connection

Except for Ethernet Switches and Daisy Chain IP Controllers, devices must not have more than one Ethernet connection to IP networks unless doing so is required by the project specifications and the specific application is approved. If a device with Multiple Ethernet Connections to IP networks is required, provide a Multiple Ethernet Connection Device Request using the Multiple Ethernet Connection Device Request Template at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 to request approval for each device. If a device with Multiple Ethernet Connections to IP networks is not required, instead provide a document stating that no approval is being requested.

3.2.4 Cryptographic Protection

{For Government Reference Only: This subpart relates to IA-2(9), IA-3(1), SC-8, SC-13, SC-23(1), SC-23(3); CCI-001942, CCI-001959, CCI-001967, CCI-002418, CCI-002449, CCI-002450, CCI-001185, CCI-001188, CCI-001664.}

All remote user interfaces must use HTTPS for all traffic between the user interface client and user interface server.

For devices that have STIG/SRGs related to cryptographic protection (CCI-002450), comply with the requirements of those STIG/SRGs. Ensure that all IP network traffic is encrypted using NSA-approved cryptography;

provision of digital signatures and hashing, and FIPS-validated cryptography.

3.2.5 Device Identification and Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-3; CCI-000777, CCI-000778, CCI-001958.}

All computers must support IEEE 802.1x for device authentication to the network.

3.2.5.1 For HVAC Control System Devices

Devices using HTTP as a control protocol must use HTTPS instead. Devices using Ethernet must support IEEE 802.1x. Devices using Fox Protocol must support IEEE 802.1x. Devices using BACnet must support network security as specified for BACnet Secure Connect in ASHRAE 135.

3.2.5.2 For Lighting Control System Devices

Devices using HTTP as a control protocol must use HTTPS instead. Devices using Fox Protocol must support IEEE 802.1x. Devices using Ethernet must support IEEE 802.1x. Devices using BACnet must support network security as specified for BACnet Secure Connect in ASHRAE 135.

3.2.5.3 Default Requirements for Control System Devices

For control system devices where Device Identification and Authentication requirements are not otherwise indicated in this Section: Devices using HTTP as a control protocol must use HTTPS instead.

3.2.6 Cryptographic Module Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-7; CCI-000803}

For devices (including but not limited to NIST FIPS 140-2 compliant radios) that have STIG/SRGs related to cryptographic module authentication (CCI-000803), comply with the requirements of those STIG/SRGs.

3.3 ACCESS CONTROL REQUIREMENTS

3.3.1 User Accounts

{For Government Reference Only: This subpart (and its subparts) relate to AC-2(a), AC-3, AC-6(1), AC-6(10), AC-6(2), AC-6(9), CM-11(2), and IA-2; CCI-002110, CCI-000213, CCI-002235, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-001812, and CCI-000764.}

Any user interface supporting user accounts (either FULLY or MINIMALLY) must limit access according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

All user interfaces FULLY supporting accounts must implement user-based authentication where each account is uniquely assigned to a specific user. User interfaces FULLY supporting accounts must implement at least three (3) levels of user account privilege including: 1) an account with

read-only permissions 2) an account with full permissions including account creation and modification and 3) an account with greater permissions than read-only but without account creation and modification.

3.3.1.1 Computers

All computer operating systems must FULLY support user accounts and implement accounts for access. Each control system software application not supporting accounts and running on a computer must be installed such that use of the software is restricted by the computer operating system to specific users.

Applications running on computers shall not require the user be logged in to a computer operating system administrator account for normal operation. It is permissible to require the computer operating system administrator account for initial application installation and configuration.

3.3.1.2 Controllers

For user interfaces provided by controllers, provide access control in accordance with the User Interface Requirements table for the applicable control system and user interface type.

a. For table entries of "NA": NA means Not Applicable, there are no interfaces in this category.

b. For table entries of "None Required": The user interface is not required to support user accounts.

c. For table entries of "MINIMALLY": The user interface must at least MINIMALLY support user accounts.

d. For table entries of "FULLY": The user interface must at FULLY support user accounts.

e. For table entries of "KEY": The user interface must have physical security in the form of either a key lock on the interface itself or be furnished inside a locked enclosure. Where this is required for a read only interface, this lock must prevent viewing of data on the interface; for other interfaces, this lock must prevent using the interface to alter data.

f. For table entries of "Physical Security": For Local FULL interfaces, the interface must be located inside mission space. For Local Limited (not FULL) interfaces, the user interface must either a) be located within mission space or b) be protected by physical security at least as good as the control devices (and equipment controlled by the control devices) affected by the interface. For purposes of this requirement, 'affected' includes controllers with data that can be directly altered by the interface, as well as mechanical and/or electrical equipment directly controlled by those controllers, but does not include other interactions.

g. Entries of the form "X and Y" must meet both the requirement indicated for X and the requirement indicated for Y. For example, an entry of "MINIMALLY and Physical Security" indicates the user interface must both MINIMALLY support accounts and have physical security.

h. Entries of the form "X or Y" must meet either the requirement indicated for X or the requirement indicated for Y.

3.3.1.2.1 HVAC Control Systems

| User Interface Requirements for LOW Impact HVAC Control Systems | |
|---|---|
| **User Interface Type** | **Access Control Requirement** |
| Local Read Only (see note 1) | None Required |
| Local Limited, Non-privileged | None Required |
| Local Limited, Privileged | Physical Security |
| Local Full | MINIMALLY |
| Remote Read Only | None Required |
| Remote Limited, Non-Privileged | MINIMALLY |
| Remote Limited, Privileged AND Remote Full (see note 2) | FULLY |
| Notes:<br>1)Local Read Only User Interfaces are always Non-Privileged<br>2)Remote Full User Interfaces are always Privileged | |

3.3.1.2.2 Lighting Control Systems

| User Interface Requirements for LOW Impact Lighting Control Systems | |
|---|---|
| **User Interface Type** | **Access Control Requirement** |
| Local Read Only (see note 1) | None Required |
| Local Limited, Non-privileged | None Required |
| Local Limited, Privileged | Physical Security |
| Local Full | MINIMALLY |
| Remote Read Only | None Required |
| Remote Limited, Non-Privileged | MINIMALLY |
| Remote Limited, Privileged AND Remote Full (see note 2) | FULLY |

| User Interface Requirements for LOW Impact Lighting Control Systems | |
|---|---|
| **User Interface Type** | **Access Control Requirement** |
| Notes:<br>1)Local Read Only User Interfaces are always Non-Privileged<br>2)Remote Full User Interfaces are always Privileged | |

3.3.2 Unsuccessful Logon Attempts

{For Government Reference Only: This subpart (and its subparts) relate to 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. If a device cannot meet these requirements, document device capabilities to protect from subsequent logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures in lieu of the indicated requirements without explicit permission from the Government. If no Device Account Lock Exceptions are requested, provide a document stating that no approval is being requested as the Device Account Lock Exception Request.

3.3.2.1 Devices MINIMALLY Supporting Accounts

For LOW Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts must lock the user account after five consecutive failed login attempts and must unlock the user account after 15 minutes have elapsed without an unsuccessful login attempt or by a successful login to a separate administrator account.

3.3.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements.

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. If the account being locked is the sole administrator account on the device, the account must stay locked for 1 hour and then automatically unlock.

c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

There are no high availability interfaces which are exempt from unsuccessful logon attempts requirements.

3.3.3 System Use Notification

{For Government 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}

3.3.3.1 System Use Notification for Remote User Interfaces

Remote user interfaces must display a warning banner meeting the requirements of DTM 08-060 on screen.

3.3.3.2 System Use Notification for Local User Interfaces

Devices which are connected to a network and have a local user interface must display a warning banner meeting the requirements of DTM 08-060 on the user interface screen if capable of doing so and must have a permanently affixed label with an approved banner from DTM 08-060 if unable to display the warning banner on the screen. Where it is impractical (perhaps due to device size) to affix the label to the device, affix the label to the device enclosure.

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.

3.3.4 Permitted Actions Without Identification or Authentication

{For Government 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.

3.3.5 Enclosures

Prior to final acceptance of the system, lock all lockable enclosures. Submit an Enclosure Keys submittal with all copies of keys for all enclosures and a key inventory list documenting all keys. Label each key with the matching enclosure identifier.

3.4 USER IDENTIFICATION AND AUTHENTICATION

{For Government Reference Only: This subpart (and its subparts) relates to IA-2, IA-2(1),IA-2(12), IA-5 IA-5(b), IA-5(c), IA-5(e), IA-5(g), IA-5(1), IA-5(11); CCI-000764, CCI-000765, CCI-001953, CCI-001954, 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. }

This subpart indicates requirements for specific methods of identification and authentication for users and user accounts. Where these requirements conflict apply the following order of precedence: 1) If present, Device Specific Requirements take precedence over any other requirements; and then 2) multifactor authentication requirements take precedence over password requirements.

3.4.1 User Identification and Authentication for All System Types

Unless otherwise indicated, all user interfaces supporting accounts (either FULLY or MINIMALLY) must implement Identification and Authorization via passwords.

For LOW Impact Systems: User interfaces provided by computer operating systems must implement multifactor authentication via PIV.

3.4.2 User Identification and Authentication for Specific System Types

System specific requirements are in addition to and supersede those indicated for all system types. When no additional requirements are indicated for a specific system type the requirements for all systems still apply to that system type.

3.4.2.1 HVAC Control Systems Devices

No additional system specific requirements apply.

3.4.2.2 Lighting Control Systems Devices

No additional system specific requirements apply.

3.4.3 User Identification and Authentication for Specific Devices

There are no additional device specific user interface requirements.

3.4.4 Implementation of Identification and Authorization Requirements

Identification and Authorization must be met by one of the following methods:

a. Direct implementation in the user interface.

b. For user interfaces on a computer: inheriting the Identification and Authorization from the computer operating system, either by the operating system limiting access to specific applications by user, or by the application itself having permissions based on the user logged into the computer.

c. For remote interfaces: an implementation shared between the remote user interface server and the remote user interface client. For example, a requirement for PIV authentication may be met on a remote user interface by a PIV reader on a web browser client which sends the authentication information via HTTPS to the remote server.

3.4.5 Password-Based Authentication Requirements

3.4.5.1 Passwords for Software and Applications Running on Computers

All software and applications running on 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. The list of supported special characters must include at least 4 separate characters.

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 (where location is significant, a character may be reused if it is in a different position).

i. Passwords must be cryptographically protected during storage and transmission.

3.4.5.2 Passwords for Controllers FULLY Supporting Accounts

All controllers 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. The list of supported special characters must include at least 4 separate characters.

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.

3.4.5.3 Passwords for Remote Interfaces

Passwords for connecting to a Remote User Interface 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. The list of supported special characters must include at least 4 separate characters.

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 (where location is significant, a character may be reused if it is in a different position).

h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.4 Passwords for Devices Minimally Supporting Accounts

Devices MINIMALLY supporting accounts must support passwords with a minimum length of four characters.

3.4.5.5 Password Configuration and Reporting

For all devices with a password, coordinate the changing of passwords with the project site following testing of the system but prior to turnover to the Government. Coordinate with Password Point of Contact to determine appropriate project site personnel to complete password changes. Accompany identified personnel to each device with a password and instruct personnel on the process of changing password. Record the time, date and personnel present when each device's password is changed and submit a Password Change Summary Report documenting this information.

Provide the Password Summary Report electronically in both PDF and Microsoft Excel.

3.4.6 Authenticator Feedback

{For Government 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.

3.5 CYBERSECURITY AUDITING

Where an auditing requirement exists for email notification, notify via email the application administrator and Information System Security Officer (ISSO) of the event. Coordinate with the Email Address Point of Contact for email addresses. If outgoing email is not available to the system, configure the system for these notifications for future support of outgoing email.

3.5.1 Audit Events, Content of Audit Records, and Audit Generation

{For Government Reference Only: This subpart (and its subparts) relates

to AU-2(a), AU-2(c), AU-2(d), AU-3, AU-10, AU-12, AU-13(3), AU-14(b), AU-14(1), AU-14(2), AU-14(3), CM-5(1), SC-7 (9); CCI-000123, CCI-001571, CCI-000125, CCI-001485, CCI-000130, CCI-000131, CCI-000132, CCI-00133, CCI-000134, CCI-001487, CCI-000166, CCI-001899, CCI-000169, CCI-001459, CCI-000171, CCI-000172, CCI-001910, CCI-001914, CCI-001919, CCI-001464, CCI-001462, CCI-001920, CCI-001814, CCI-002400. }

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.

If auditing requirements can be met using existing control system alarm or event capabilities, those existing capabilities may be used to meet these requirements.

3.5.1.1 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

3.5.1.1.1 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. Successful logouts

d. Privileged activities or other system level access

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

3.5.1.1.2 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

3.5.1.2 For HVAC Control System Controllers

3.5.1.2.1 HVAC Control System Controllers FULLY Supporting User Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.2.1.1 Audited Events

Configure each controller to audit the following events:

a. Successful and unsuccessful logon attempts to the controller

b. Successful logouts

c. All account creations, modifications, disabling, and terminations.

d. All controller shutdown and startup

3.5.1.2.1.2 Audit Event Information To Record

Configure each controller 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. the identity of any individuals or subjects associated with the event

3.5.1.2.2 Other HVAC Control System Controllers

There are no requirements to perform auditing at HVAC field controllers that do not FULLY support accounts.

3.5.1.3 For Lighting Control System Controller

3.5.1.3.1 Lighting Control System Controllers FULLY Supporting User Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.3.2 Other Lighting Control System Controllers

There are no requirements to perform auditing at Lighting field controllers that do not FULLY support accounts.

3.5.1.4 Default Requirements for Control System Controllers

For control system controllers where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

3.5.1.4.1 Controllers Which FULLY Support Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.4.1.1 Audited Events

Configure each controller 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. Successful logouts

d. Concurrent logons from different workstations

e. All account creations, modifications, disabling, and terminations.

f. All kernel module load, unload, and restart

3.5.1.4.1.2 Audit Event Information To Record

Configure each controller 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

3.5.1.4.2 Controllers Which Do Not FULLY Support Accounts

For each controller which does not FULLY support accounts configure the controller to audit all controller shutdown and startup events and to record for each event the type of event and when the event occurred.

3.5.2 Audit Time Stamps

{For Government Reference Only: This subpart (and its subparts) relates to AU-8; CCI-000159, CCI-001889, CCI-001890.}

Any device (computer or controller) generating audit records must have an

internal clock capable of providing time with a resolution of one second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device (computer or controller) generating audit records maintains accurate time to within 1 second. Note that if the control system specifications include requirement for clocks, the most stringent requirement applies.

3.5.3 Auditing Front End Software

The project site currently has the following software to support control system auditing: none. If there is no existing auditing front end software or the software is not compatible with the provided control systems, provide Auditing Front End Software with audit log import and upload, export, notification, and analysis functionality. The Auditing Front End Software may be provided as a component of the control system front end or as a separate software package, and a single package may serve multiple control systems provided under the same projects if they are sharing a cybersecurity authorization.

When the Auditing Front End Software is neither existing nor installed under the requirements of another Section, furnish the Auditing Front End Software media and license and install the software on the control system front end computer. Submit copies of Auditing Front End Software if this function is not part of the software provided with the control system to meet requirements of other Sections.

3.5.3.1 Import and Upload Requirements

Auditing Front End Software must be capable of importing audit logs from the Device Audit Record Upload Software and of uploading audit logs over the network from all control system devices supporting network upload of audit logs.

3.5.3.2 Export Requirements

Auditing Front End Software must be capable of exporting to a file format supported by Microsoft Excel.

3.5.4 Audit Storage Capacity and Audit Upload

{For Government Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

The creation of audit records must never interfere with normal device operation. Devices must cease collection of auditing information if required to maintain normal operation.

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 controllers capable of generating audit records, provide 60 days worth of secure local storage, assuming 10 auditable events per day.

c. For computers, provide storage for at least 20 MB of audit records.

3.5.4.1 Device Audit Record Upload Software

For each device (computer or controller) required to audit events and for

which audit logs cannot be uploaded over the network by the Auditing Front End Software, provide and license to the Government software implementing a secure mechanism of uploading audit records from the device and exporting them to the Auditing Front End Software. Where different devices use different software, provide software of each type required to upload audit logs from all devices.

When Device Audit Record Upload Software is capable of uploading audit logs over the network, install Device Audit Record Upload Software on the same computer as the Auditing Front End Software. Submit copies of device audit record upload software if this function is not part of the software provided with the control system to meet requirements of other Sections. If there are no devices requiring this software, provide a document stating this in lieu of this submittal.

3.5.5 Response to Audit Processing Failures

{For Government Reference Only: This subpart (and its subparts) relates to AU-5; CCI-000139, CCI-000140, CCI-001490.}

In the case of a failure in the auditing system, computers associated with auditing must provide email notification. In case of an audit failure, if possible, continue to collect audit records by overwriting existing audit records.

3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Government Reference Only: This subpart (and its subparts), along with the network communication report submittal specified elsewhere in this section, relates to CM-6(a), CM-6(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.

3.6.1 Device Capabilities

For HVAC Control Systems: Do not provide devices with remote user interfaces or with full 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 Lighting Control Systems: Do not provide devices with remote user interfaces or with full user interfaces where one was not required.

For Other Control Systems: For LOW Impact Systems: Do not provide devices with remote user interfaces or with full user interfaces where one was not required.

3.6.2 Software

For software that has a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port access for least functionality), install and configure the software in accordance with that STIG or SRG.

## 3.7 SYSTEM AND COMMUNICATION PROTECTION

### 3.7.1 Collaborative Computing

{For Government Reference Only: This subpart relates to SC-15(a), SC-15(b); CCI-001150, CCI-001152.}

Without explicit approval from the project site, control systems must not use collaborative computing technologies.

### 3.7.2 Denial of Service Protection

{For Government Reference Only: This subpart relates to SC-5, SC-39, SC-7(a); CCI-001093, CCI-002385, CCI-002386, CCI-002430, CCI-001097. }

To the greatest extent practical, implement control logic without reliance on the network. Except when required to meet the requirements of the control system Section (where the requirement can only be met using computer hardware), do not implement control logic in computers.

## 3.8 SAFE MODE AND FAIL SAFE OPERATION

{For Government Reference Only: This subpart (and its subparts) relates to CP-12, SI-10(3), SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002754, 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.

## 3.9 SYSTEM MAINTENANCE TOOL SOFTWARE

{For Government Reference Only: This subpart (and its subparts) relates to MA-3; CCI-000865.}

Submit and license to the Government all software required to operate, maintain and modify the control system such 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. Submit hard copies of user manuals for each software with the software submittal.

For software provided and licensed to the Government under the requirements of another Section, submit a statement indicating the Section and Submittal under which the software was provided. For software provided to meet the requirements of this Section and not provided and licensed under another Section, submit software and software user manuals on DVD or CD as a Technical Data Package and submit two hard copies of the software user manual for each piece of software.

## 3.10 DEVICE POWER

{For Government Reference Only: This subpart (and its subparts) relates to PE-11, PE-11(1); CCI-002955, CCI-000961. }

For LOW Impact Systems: Provide emergency power in accordance with the control system and equipment specification Sections.

## 3.11 VULNERABILITY SCANNING

{For Government Reference Only: This subpart (and its subparts) relates to RA-5 RA-5(a),RA-5(b),RA-5(c),RA-5(d); CCI-001054, CCI-001055, CCI-000156, 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.

### 3.11.1 Computers and Software Running on Computers

Computers and applications running on computers must meet relevant vulnerability scanning STIGs/SRGs and respond to approved DoD vulnerability scanning tools.

### 3.11.2 Controllers

Controllers shall be scannable by standard control system discovery tools or control system browsers and return meaningful status information including the network inputs and outputs for the controller. This information shall contain sufficient detail to detect vulnerabilities or exploits of the controller.

Provide all software needed to scan the control system as the Control System Scanning Tools submittal. If the software required to scan the system is already installed at the project site or is provided under a separate section instead provide a statement indicating this.

## 3.12 FIPS 201-2 REQUIREMENT

{For Government Reference Only: This subpart (and its subparts) relates to SA-4 (10); CCI-003116}

Devices in the following systems which implement PIV must be on the NIST FIPS 201-2 approved product list ( https://www.idmanagement.gov/approved-products-list/).

## 3.13 SYSTEM AND INTEGRATION INTEGRITY

### 3.13.1 Malicious Code Protection

{For Government Reference Only: This subpart (and its subparts) relates to SI-3(c); CCI-001241, CCI-002623}

For all computers installed under this project, provide malware protection software media, provide licenses, and install and configure malware protection software as indicated. Coordinate with the Government Computer Access Point of Contact as required.

a. Provide malware protection software licenses.

b. Provide malware protection software media.

c. Install and configure malware protection software in accordance with the relevant STIGs.

## 3.14 CONTROL SYSTEM CYBERSECURITY TESTING

### 3.14.1 Control System Cybersecurity Testing Procedures

Prepare Control System Cybersecurity Testing Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system meets the requirements of this Section.

Submit 4 copies of the Control System Cybersecurity Testing Procedures. The Control System Cybersecurity Testing Procedures may be submitted as a Technical Data Package.

### 3.14.2 Control System Cybersecurity Testing Execution

Using the Control System Cybersecurity Testing Procedures verify that the control system meets the requirements of this Section. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. If testing reveals deficiencies in the system, correct the deficiency and retest until successful.

### 3.14.3 Control System Cybersecurity Testing Report

Prepare and submit a Control System Cybersecurity Testing Report documenting all tests performed and their results. Include all tests in the Control System Cybersecurity Testing Procedures and any additional tests performed during testing. Document test failures and repairs conducted with the test results.

Submit four copies of the Control System Cybersecurity Testing Report. The Control System Cybersecurity Testing Report may be submitted as a Technical Data Package.

## 3.15 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT

In addition to testing and testing support required by other Sections, provide a minimum of 40 hours of technical support for cybersecurity testing of control systems to support the DoD Risk Management Framework process Cybersecurity assessment of the control system. This support is independent of (and in addition to) the Control System Cybersecurity Testing specified in this section.

## 3.16 CYBERSECURITY TRAINING

Provide eight hours of classroom and hands-on training for six Government personnel on the cybersecurity operation and maintenance of the control system provided. This training is in addition to and must be coordinated with control system training specified in other Sections.

The Government will provide the training location. Training must cover, at a minimum: (a) applying software and firmware updates, (b) user account creation, modification and deletion, (c) audit log upload procedures and (d) identification of privileged user interfaces and system impact of those interfaces. Training session must include a question and answer period during which government staff questions about cybersecurity aspects of the control system are answered.

-- End of Section --

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SECTION 25 05 11.28

CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS - ELECTRONIC SECURITY SYSTEMS
**05/21**

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 https://public.cyber.mil/stigs/downloads/ and an SRG/STIG Applicability Guide and Collection Tool is available at https://public.cyber.mil/stigs/SCAP/. Not all control system components have applicable STIGs or SRGs. The "Control Systems SRG" does not apply to work performed under this Section; all requirements within this section to apply applicable SRGs DO NOT include the "Control Systems SRG".

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: Electronic Security Systems including Access Control and Intrusion Detection Systems.

1.2 RELATED REQUIREMENTS

This section does not contain sufficient requirements to procure a control system and must be used in conjunction with other Sections which specify control systems. This Section adds cybersecurity requirements to the control systems specified in other Sections, to include without constraint Section 28 10 05 ELECTRONIC SECURITY SYSTEM (ESS), and as these requirements are conditioned on the control system being provided, which includes proprietary instrumentation and components to match infrastructure in support of existing system accreditation; there may be requirements in this Section that will not apply to this project. 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.

In cases where a requirement is specified in both this Section and in another Section, the more stringent requirement must be met. In cases where a requirement in this Section conflicts with the requirements of another Section such that both requirements cannot be met at the same time, request direction from the Contracting Officer Representative to

determine which requirement applies to the project.

Note that the facility electronic security system must be compatible with existing Vindicator SMS/PACS front end. Coordination with the Government is required for any additional configurations regarding connection to site-specific network infrastructure.

## 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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE 802.1x | (2010) Local and Metropolitan Area Networks - Port Based Network Access Control |

INTERNET ENGINEERING TASK FORCE (IETF)

| | |
|---|---|
| IETF RFC 2819 | (2000) Remote Network Monitoring (RMON) Management Information Base (MIB) |

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

| | |
|---|---|
| NIST FIPS 140-2 | (2001) Security Requirements for Cryptographic Modules |
| NIST FIPS 201-2 | (2013) Personal Identity Verification (PIV) of Federal Employees and Contractors |

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 Administrator Account

An administrator account is an account with full permissions to a device, application, or operating system, including the ability to create and modify other user accounts.

Note that the operating system Administrator Account may be different than Administrator Accounts for applications hosted on that operating system. Also, most controllers will not have any support for accounts and will therefore not have an 'Administrator Account'.

### 1.4.2 Computer

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 Operating System, where Android is considered separate from Linux

e. a device running a version of Apple iOS

Unless otherwise indicated or clear from context use of the word "device" in this Section includes computers.

1.4.3 Controller

A device other than a computer or Ethernet switch.

1.4.4 Mission Space

A device or media is in mission space if physical access to the device or media is controlled by the organization served by the device. For example, a VAV box controller in a suspended ceiling is in mission space if the VAV box serves that room; an electrical switchgear in an electrical room or an AHU in a mechanical room or on a rooftop may still be considered to be in mission space if the organization (mission) served by that switchgear or AHU controls access to the electrical room, mechanical room or rooftop.

1.4.5 Network

A network is a group of two or more devices that can communicate using a network protocol. Network protocols must provide a method for addressing devices on the network; a communication method that does not provide an addressing scheme is not a networked form of communication. Devices that communicate using a method of communication that does not support device addressing are not using a network.

1.4.6 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 (unlike many IT definitions of "Network Connected") 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).

1.4.6.1 Wireless Network Connected

Any device that supports wireless network communication is network connected to a wireless network, regardless of whether the device is communicating using wireless. Unless physically disabled, devices with wireless transceivers support wireless, it is not sufficient to disable the wireless in software.

1.4.7 Network Media

The thing that provides the communication channel between the devices on a network. Typically wire, but might include wireless, fiber optic, or even power line (some network protocols allow sending network signals over power wiring).

1.4.8 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

1.4.8.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts. These devices support user-based (as opposed to role-based) authentication.

1.4.8.2 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 "username and password" structure). These devices typically only support role-based authentication.

Examples of devices which MINIMALLY support accounts are a) a variable frequency drive with a single account which requires a PIN for access to configuration; and b) a room lighting control touchpad interface that has a single account.

1.4.8.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.9 Manual Local Input

Manual Local Inputs are system analog or binary inputs that are adjustable by a person but are, by intrinsic hardware design, very limited in potential capabilities. Manual Local Inputs do not have touch screens or full keyboards, but may have a few buttons or dials to allow input. Manual Local Inputs do not have full graphic screens or dot-matrix displays, but may have simple lights (LEDs) or 7-segment displays. Manual Local Inputs do not have any sort of menu structure, each button has a single well-defined function.

Examples of Manual Local Inputs are H-O-A switches, simple thermostats, and disconnect switches.

1.4.10 Card Reader

A card reader is an input/output device whose primary function is to assist in two-factor authentication. A card reader must have an interface to read data from a card and may be able to write data to a card. A card reader may have a means (such as buttons, keypad, touchscreen, etc.) for a user to input a PIN or password, as well as a limited display.

### 1.4.11 User Interface

A User Interface (UI) is something other than a Manual Local Input or Card Reader that allows a person to interact with the system or device. Note that while a Card Reader is not by itself a User Interface, a User Interface may contain a Card Reader in order for it to authenticate its user. Within control systems, there are a wide range of User Interfaces.

Two important distinctions are 1) whether the user interface is Local or Remote, and 2) the effective capabilities of the User Interface to alter data, which is the "privilege" of the user interface (where effective privilege available to a specific user at a specific user interface is the combination of the greatest privilege offered by the user interface and the specific account the user is logged into).

#### 1.4.11.1 Local User Interface

A Local User Interface is a user interface where the physical hardware the user interacts with (keyboard, buttons, display, etc.) is physically part of the device being affected. All of the relevant characteristics of the user interface are embodied within a single device.

Note that a Local UI may be able to access data in a different device, Local versus Remote in this context refers to the user interface itself; the capability to access data in a different device is covered under "Full User Interface".

#### 1.4.11.2 Remote User Interface

A Remote User Interface implements a Client/Server model where the physical hardware the user interacts with (Client) is physically distinct from the device being affected (Server). Most or all of the security and functionality characteristics of the user interface are defined by the Server, not the Client. The Client and Server communicate via a network connection. A common example of a remote user interface is a web-based interface where the browser (client) is generally on different hardware than the web server (server). A Remote UI remains a Remote UI even if the user happens to be at a Client on the same hardware as the Server. What is important is that a) the Client may be on different hardware than the Server and b) the majority of the security and functional characteristics of the interface are defined at the Server.

Note that this definition of "remote" is consistent with that generally used in the control industry but is not aligned with the NIST 800-53 definition of "Remote", which refers to "outside the system". The term "Remote" here better aligns with the NIST 800-53 definition of "Network" (remote from within the system) Access.

#### 1.4.11.3 Types of User Interface (by capability)

User interfaces are also categorized by their capabilities as being Read Only, Limited, or Full.

##### 1.4.11.3.1 Read-Only User Interface

A Read Only User Interface (also referred to as a View-Only User Interface) is a user interface that only allows for reading data, it does not allow (have the capability to) modify data. A Read Only User

Interface may be either Local or Remote. A User Interface that is configured to be Read Only (by some other means than the interface itself, such as using configuration software on a laptop) is a Read-Only Interface. Note a Read Only User Interface may have buttons (or touch screen, etc.) allowing the user to navigate through the presentation of data.

Examples of a Read Only User Interfaces are a) a publicly viewable "energy dashboard" showing weather data and energy usage within a building and b) digital wayfinding signage.

1.4.11.3.2 Limited User Interface

A Limited User Interface is a user interface that - by design - can only alter information local to the user interface. Note that the determination of "alter" includes only direct interactions, it explicitly excludes interactions that might occur as secondary effects. For example, an interface changing the flow setpoint in a pump controller is a direct interaction, the subsequent change in flow (as well as any subsequent downstream changes in valve position) are not direct interactions.

Two examples of LIMITED UIs are: a) a variable speed drive has a Limited Local User Interface which allows the user to change properties within the drive, but does not allow affecting things outside the drive; and b) a typical home WiFi Router has a Limited Remote User Interface which allows configuration of the Router, but does not allow direct interaction with other devices.

1.4.11.3.3 Full User Interface

A Full User Interface can alter information in devices outside the device with the user interface. For example, a typical Local Display Panel is a Full Local User Interface while a browser-based front end is a Full Remote User Interface.

1.4.11.3.4 View-Only User Interface

See Read-Only User Interface

1.4.11.4 Other User Interface Terminology

In addition to defining whether a user interface is a Hardware Limited, Read-Only, Limited or Full, and whether it is Local or Remote, user interfaces are classified by whether they are writable or privileged.

1.4.11.4.1 Writable User Interface

Any User Interface that is not Read-Only is Writable. (Limited User Interfaces and Full User Interfaces are both writable user interfaces (as they are capable of changing a value)).

1.4.11.4.2 Privileged User Interface

A Privileged UI is a UI that has sufficient capabilities or functionality that it requires specific cybersecurity measures to be put in place to limit its unauthorized use. Ultimately, whether a specific user interface is considered a Privileged User Interface must be determined by usage. Unless otherwise specified, user interfaces can be determined to be privileged or not using the following:

a. Read-Only User Interfaces are not privileged user interfaces.

b. User interfaces that allow for configuration of auditing or allows for modification or deletion of audit logs are privileged user interface.

c. User interfaces that allow for reprogramming a network connected device is a privileged user interface.

d. Writeable User Interfaces in Electronic Security Systems (ESS) are privileged user interfaces.

e. Except as specified above, a Limited User Interface must be determined to be privileged or not based on the specific capabilities and use case of the user interface. In general however, user interfaces that do not offer significant capabilities above and beyond those available at that location via other means (e.g. such as a disconnect switch, breaker, or hand-off-auto switch, or physical attack) are not privileged.

1.4.12 Wireless Network

Any network that communicates without using wires or fiber optics as the communication media. Wireless networks include: WiFi, Bluetooth, ZigBee, cellular, satellite, 900 MHz radio, 2.4 GHz, free space optical, point-to-point laser, and IR.

1.4.13 Wired Broadcast Network

Wired Broadcast Networks are any network, such as powerline carrier networks and modem (wired telephony), that use wire-based technologies where there is not a clearly defined boundary for signal propagation.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Points of Contact

Coordinate with the following Points of Contact as indicated in this Section and as required. Not all projects will require coordination with all Points of Contact. When coordination is required and no Point of Contact is indicated, coordinate with The Contracting Office Representative (COR).

a. Government Computer Access Point of Contact: The Contracting Office Representative (COR)

b. HTTPS Certificate Point of Contact: The Contracting Office Representative (COR)

c. Email Address Point of Contact: The Contracting Office Representative (COR)

d. Password Point of Contact: The Contracting Office Representative (COR)

e. PKI Infrastructure Point of Contact: The Contracting Office Representative (COR)

f. Electronic Security Point of Contact: 28 SFS/S-5C Representative - Lori Watson

1.5.2 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 or wired broadcast communication, the Wireless and Wired Broadcast Communication Request submittal must be approved prior to control system device selection and installation.

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 installation.

c. If requesting permission for the use of a device with multiple physical connections to IP networks, the Multiple IP Connection Device Request must be approved prior to control system device selection and installation.

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.

f. The Cybersecurity Interconnection Schedule must be coordinated with other work that will be interconnected to, and interconnections must be approved by the Government before relying on them for system functionality.

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, HTTPS web server certificates must be obtained from the indicated HTTPS Certificate Point of Contact.

j. Contractor Computer Cybersecurity Compliance Statements must be provided for each contractor using contractor owned computers.

k. Installation of electronic security instrumentation and components must meet cybersecurity requirements in support of existing accreditations for the Integrated Base Defense Security System (IBDSS).

1.6 SUBMITTALS

Government approval is required for submittals with a "G"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

Device Account Lock Exception Request; G-RO

Multiple Ethernet Connection Device Request; G-RO

Contractor Computer Cybersecurity Compliance Statements; G-RO

Cybersecurity Subject Matter Expert Qualifications; G-RO

Contractor Temporary Network Cybersecurity Compliance Statements; G-RO

Cybersecurity Interconnection Schedule; G-RO

Protection of Information At Rest Proposal; G-RO

Proposed STIG And SRG Applicability Report; G-AE

SD-02 Shop Drawings

Network Communication Report; G-AE

Cybersecurity Riser Diagram; G-AE

SD-03 Product Data

Control System Cybersecurity Documentation; G-AE

SD-07 Certificates

Software Licenses; G-RO

SD-11 Closeout Submittals

Password Change Summary Report; G-RO

Enclosure Keys; G-RO

Software and Configuration Backups; G-RO

Auditing Front End Software; G-RO

Device Audit Record Upload Software; G-RO

System Maintenance Tool Software; G-RO

Control System Scanning Tools; G-RO

STIG, SRG and Vendor Guide Compliance Result Report; G-RO

Control System Inventory Report; G-RO

Integrity Verification Software; G-RO

## 1.7 QUALITY CONTROL

### 1.7.1 Qualifications

For the positions listed below resumes should be submitted to the Government within 14 days after notice to proceed. All certifications must be in effect prior to being hired.These positions may serve across the contract.

### 1.7.2 Cybersecurity Subject Matter Expert Qualifications

The individual will oversee all work within this specification. This position requires that the individual currently meet Information Assurance Manager Level II in accordance with DoD 8570.01-M, Information Workforce Improvement Program, and DoD 8140.01, Cyberspace Workforce Management Program.

## 1.8 CYBERSECURITY DOCUMENTATION

{For Government Reference Only: This subpart (and its subparts) relates to PL-7; CCI-003071}

### 1.8.1 Proposed STIG and SRG Applicability Report

For each model of network connected or network infrastructure device, use the DISA SRG/STIG Applicability Guide and Collection Tool (available at https://public.cyber.mil/stigs/SCAP/to identify applicable STIGs or SRGs and provide a report indicating applicable STIGs and SRGs for each model.

### 1.8.2 Cybersecurity Interconnection Schedule

{For Government Reference Only: This subpart relates to CA-3(b), PL-8, SC-7(9), SC-7(11); CCI-000258, CCI-003072, CCI-003073, CCI-003075, CCI-002398, CCI-002399, CCI-002401, CCI-002402, CCI-002403.}

Provide a completed Cybersecurity Interconnection Schedule documenting network connections between the installed system and other systems. Provide the following information for each device directly communicating between systems: Device Identifier, Device Description, Transport layer Protocol, Network Address, Port (if applicable), MAC (Layer 2) address (if applicable), Media, Application Protocol, Service (if applicable), Descriptive Purpose of communication. For MODERATE Impact Systems: Also describe the impact of loss of the connection on the control system. 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 Cybersecurity Interconnection Schedule as an editable Microsoft Excel file (a template Cybersecurity Interconnection Schedule in Excel format is available at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1

### 1.8.3 Network Communication Report

{For Government Reference Only: This subpart (and its subparts) relates to CA-9, PL-8; CCI-003075; CCI-002102, CCI-002103, CCI-002104, CCI-002105, CCI-003072, CCI-003073, CCI-003075 and also the submittal requirements associated with CM-6, CM-7, SC-8 and SC-41 including CM-7(3), CCI-000388.}

Provide a network communication report. For each networked device, document the communication characteristics of the device including communication protocols, services used, encryption employed, and a general description of what information is communicated over the network. For each device using IP, document all TCP and UDP ports used. For non-IP communications, document communication protocol and media 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.

1.8.4 Control System Inventory Report

{For Government Reference Only: This subpart (and its subparts) relates to CM-8(a), SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, 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 https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 documenting all networked devices, including network infrastructure devices. 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.

1.8.5 Software and Configuration Backups

{For Government Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each computer and control system device on which software is installed or a configuration file is modfied under this project, provide a recovery image of the final as-built computer or device. 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. If additional user permissions are required to meet this requirement, coordinate the creation of the image with the identified Government Computer Access Point of Contact.

For all ethernet switches provide a backup of the switch configuration. For all controllers, provide a backup of the controller configuration and the source code for all loaded application programs (all software that is not common to every controller of the same manufacturer and model).

If any or all of these are provided under another Section, provide documentation indicating this and referencing those submittals.

1.8.6 Cybersecurity Riser Diagram

{For Government Reference Only: This subpart (and its subparts) relates

to PL-2(a), PL-8; CCI-003051, CCI-003053, CCI-003072, CCI-003073, CCI-003075}

Provide a cybersecurity riser diagram of the complete control system including all network and device 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.

1.8.7 STIG, SRG and Vendor Guide Compliance Result Report

For every component (device or software) with an applicable STIG or SRG in the Proposed STIG and SRG Applicability Report, provide a result report documenting compliance with the STIG or SRG requirements. For components which are scannable by the SCAP (security content automation protocol) tool (available online at https://public.cyber.mil/stigs/scap), provide the SCAP report and raw scan results.

For every component (device or software) with manufacturer provided cybersecurity documentation, procedure, or method for secure configuration or installation, provide a report documenting how the component was configured and any deviation from the manufacturer instructions.

1.8.8 Control System Cybersecurity Documentation

{For Government Reference Only: 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.

1.8.8.1 Software Applications

For all software applications running on computers provide:

a. administrator documentation that describes secure configuration of the software {For Government Reference Only: relates to CCI-003124}

b. administrator documentation that describes secure installation of the software {For Government Reference Only: relates to CCI-003125}

c. administrator documentation that describes secure operation of the software {For Government Reference Only: relates to CCI-003124}

d. administrator documentation that describes effective use and maintenance of security functions or mechanisms for the software {For Government Reference Only: relates to CCI-003127}

e. administrator documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the software {For Government Reference Only: 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 {For Government Reference Only: 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 {For Government Reference Only: relates to CCI-003130}

h. user documentation that describes user responsibilities in maintaining the security of the software {For Government Reference Only: relates to CCI-003131}

## 1.9 SOFTWARE LICENSING

{For Government Reference Only: This subpart (and its subparts) relates to SI-2(a), SI-2(c), SI-7(14); CCI-001227, CCI-002605, CCI-002737}

For all software provided that has not already been licensed to the government or project site, provide a license to the Government for a period of no less than 5 years, and the license must also include the following software updates:

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

## 1.10 CYBERSECURITY DURING CONSTRUCTION

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, SA-3; CCI-000258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

### 1.10.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. Contractor computers connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

#### 1.10.1.1 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.

#### 1.10.1.2 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. Computers used on this project

must be scanned using the installed software at least once per day.

1.10.1.3 Passwords and Passphrases

The passwords and passphrases for computers, applications, and web-based applications supporting passwords 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.

1.10.1.4 User-Based Authentication

Each user must have a unique account; sharing of a single account between multiple users is prohibited.

1.10.1.5 Demonstration of Compliance

The Government has the right to require demonstration of computer compliance with these requirements at any time during the project.

1.10.1.6 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 https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 Each Statement must be signed by a cybersecurity representative for the relevant company.

1.10.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.10.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than those specifically provided or furnished for this project. Any and all access to the network from outside the project site is prohibited.

1.10.3 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.

1.10.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks, when permitted, must not interfere with existing wireless networks, must use WPA2 security and must not broadcast the network name (SSID). Network names (SSID) for wireless networks must be changed from their default values.

1.10.5 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.

1.10.6 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 https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 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.

1.11 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

All products used on this project must meet the indicated requirements, but not all products specified here will be required by every project.

2.1 ETHERNET SWITCH

Provide Open Systems Interconnection (OSI) Layer 2 Ethernet switches with the following capabilities, and with an interface to support switch configuration for these capabilities:

2.1.1 Required Functionality

Switches must:

a. Copper Ethernet ports must auto negotiate for 10, 100 and 1000 megabits-per-second links.

b. Be capable of implementing port level access control by MAC address and limit the number of MAC addresses to one MAC address per port.

c. For MODERATE Impact Systems, be capable of implementing per-port access control lists (ACLs) where the list can be filtered by source and destination IP addresses, and by source and destination UDP or TCP ports.

d. Support Remote Network Monitoring (RMON) Port Analysis in accordance with IETF RFC 2819

e. Configure target port and analysis port such that switch clones all target port traffic to analysis port.

f. Support authentication via RADIUS server (for management and 802.1x)

g. Support IEEE 802.1x network login.

2.1.2 Configuration Requirements

Switches must:

a. Support configuration save and restore.

b. Support both manual IP address assignment and acquisition of a dynamic IP address via Dynamic Host Configuration Protocol (DHCP).

c. Be capable of limiting access for configuration to one or more of: a web interface using HTTPS, a command line interface using SSH, or an SNMP connection using SNMP version 3 or later.

d. Support the ability to lock configuration capability to a dedicated management port.

2.2 DAISY CHAIN IP CONTROLLERS

Controllers used as Daisy Chain IP Controllers must be IP controllers with exactly two Ethernet network connections and basic built-in switch capabilities to allow implementation of an Ethernet network in a daisy chain architecture. Switches incorporated by Daisy Chain IP Controllers are not required to meet the requirements for Ethernet Switches as defined in this Section.

PART 3 EXECUTION

3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES

Install, configure, and harden all hardware and software furnished on this project in accordance with manufacturer provided documentation, procedures, or methods for secure configuration or installation. Do not implement specific hardening actions if that action would conflict with requireed functionality or another requirement of this Section.

3.2 NETWORK REQUIREMENTS

3.2.1 Information Flow Enforcement In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relate to AC-4; CCI-001368, CCI-001414, CCI-001548, CCI-001549, CCI-001550, CCI-001551}

Install and configure Ethernet switches to block all traffic on all ports not required by the control protocol.

3.2.2 Wireless and Wired Broadcast Communication

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, AC-18(3); CCI-001438, CCI-001439, CCI-002323, CCI-001441, CCI-002252}

Unless explicitly authorized by the Government, do not use any wireless or wired broadcast communication.

3.2.3 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.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.2.4 IP Control Networks

{For Government Reference Only: This subpart relates to CM-6(a), CM-7(a), CM-7(b), CM-7(1)(b), SC-41; CCI-001588, CCI-000381, CCI-000380, CCI-000381, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546.}

IP Networks must be Ethernet networks and must use switches which are Ethernet Switches or Daisy Chain IP Controllers as defined in this Section. 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.

3.2.4.1 IP Network Routers

Do not install any device that performs IP routing.

3.2.4.2 IP Devices With Multiple Ethernet Connection

Except for Ethernet Switches and Daisy Chain IP Controllers, devices must not have more than one Ethernet connection to IP networks unless doing so is required by the project specifications and the specific application is approved. If a device with Multiple Ethernet Connections to IP networks is required, provide a Multiple Ethernet Connection Device Request using the Multiple Ethernet Connection Device Request Template at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 to request approval for each device. If a device with Multiple Ethernet Connections to IP networks is not required, instead provide a document stating that no approval is being requested.

3.2.5 Cryptographic Protection

{For Government Reference Only: This subpart relates to IA-2(9), IA-3(1), SC-8, SC-13, SC-23(1), SC-23(3); CCI-001942, CCI-001959, CCI-001967, CCI-002418, CCI-002449, CCI-002450, CCI-001185, CCI-001188, CCI-001664.}

All remote user interfaces must use HTTPS for all traffic between the user interface client and user interface server.

For devices that have STIG/SRGs related to cryptographic protection (CCI-002450), comply with the requirements of those STIG/SRGs. Ensure that all network traffic is encrypted using NSA-approved cryptography; provision of digital signatures and hashing, and FIPS-validated cryptography.

3.2.6 Device Identification and Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-3; CCI-000777, CCI-000778, CCI-001958. For MODERATE Impact systems, this subpart (and its subparts) also relates to SC-23, SC-23(5); CCI-001184, CCI-002470.}

All computers must support and implement IEEE 802.1x for device authentication to the network.

3.2.7 Cryptographic Module Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-7; CCI-000803}

For devices (including but not limited to NIST FIPS 140-2 compliant radios) that have STIG/SRGs related to cryptographic module authentication (CCI-000803), comply with the requirements of those STIG/SRGs.

3.3 ACCESS CONTROL REQUIREMENTS

3.3.1 User Accounts

{For Government Reference Only: This subpart (and its subparts) relate to AC-2(a), AC-3, AC-6(1), AC-6(10), AC-6(2), AC-6(9), CM-11(2), and IA-2; CCI-002110, CCI-000213, CCI-002235, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-001812, and CCI-000764. For MODERATE Impact systems, this subpart (and its subparts) also relate to AC-2 (2), AC-2(3), AC-2(4), AC-6(1), and CM-5(1); CCI-001361, CCI-000017, CCI-000217, CCI-000018, CCI-001403, CCI-001404, CCI-001405, CCI-002130, CCI-001683, CCI-001684, CCI-001685, CCI-001686, CCI-002132, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-001813.}

Any user interface supporting user accounts (either FULLY or MINIMALLY) must limit access according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

All user interfaces FULLY supporting accounts must implement user-based authentication where each account is uniquely assigned to a specific user. User interfaces FULLY supporting accounts must implement at least three (3) levels of user account privilege including: 1) an account with read-only permissions 2) an account with full permissions including account creation and modification and 3) an account with greater permissions than read-only but without account creation and modification.

3.3.1.1 Computers

All computer operating systems must FULLY support user accounts and implement accounts for access. Each control system software application not supporting accounts and running on a computer must be installed such that use of the software is restricted by the computer operating system to specific users.

Applications running on computers shall not require the user be logged in to a computer operating system administrator account for normal operation. It is permissible to require the computer operating system administrator account for initial application installation and configuration.

3.3.1.2 Controllers

For user interfaces provided by controllers, provide access control in accordance with the User Interface Requirements table for the applicable control system and user interface type.

a. For table entries of "NA": NA means Not Applicable, there are no interfaces in this category.

b. For table entries of "None Required": The user interface is not required to support user accounts.

c. For table entries of "MINIMALLY": The user interface must at least MINIMALLY support user accounts.

d. For table entries of "FULLY": The user interface must at FULLY support user accounts.

e. For table entries of "KEY": The user interface must have physical security in the form of either a key lock on the interface itself or be furnished inside a locked enclosure. Where this is required for a read only interface, this lock must prevent viewing of data on the interface; for other interfaces, this lock must prevent using the interface to alter data.

f. For table entries of "Physical Security": For Local FULL interfaces, the interface must be located inside mission space. For Local Limited (not FULL) interfaces, the user interface must either a) be located within mission space or b) be protected by physical security at least as good as the control devices (and equipment controlled by the control devices) affected by the interface. For purposes of this requirement, 'affected' includes controllers with data that can be directly altered by the interface, as well as mechanical and/or electrical equipment directly controlled by those controllers, but does not include other interactions.

g. Entries of the form "X and Y" must meet both the requirement indicated for X and the requirement indicated for Y. For example, an entry of "MINIMALLY and Physical Security" indicates the user interface must both MINIMALLY support accounts and have physical security.

h. Entries of the form "X or Y" must meet either the requirement indicated for X or the requirement indicated for Y.

3.3.1.3 Additional User Account Expiration Requirements In MODERATE Impact Systems:

In addition to other user account requirements, user account expiration and auditing must be configured as indicated.

3.3.1.3.1 For Control System Applications Running on Computers

If temporary accounts are supported, expire temporary accounts 72 hours after creation. Expire all other accounts after 35 days of inactivity.

3.3.1.3.2 For Other Control System Devices FULLY Supporting Accounts

If temporary accounts are supported, expire temporary accounts 72 hours after creation. Expire all other accounts after 365 days of inactivity .

3.3.2 Unsuccessful Logon Attempts

{For Government Reference Only: This subpart (and its subparts) relate to 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. If a device cannot meet these requirements, document device capabilities to protect from subsequent logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures in lieu of the indicated requirements without explicit permission from the Government. If no Device Account Lock Exceptions are requested, provide a document stating that no approval is being requested as the Device Account Lock Exception Request.

3.3.2.1 Devices MINIMALLY Supporting Accounts

For MODERATE Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts must lock the user account accountafter five consecutive failed login attempts and must unlock the user account after 60 minutes have elapsed without an unsuccessful login attempt or by a successful login to a separate administrator account.

3.3.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements.

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. If the account being locked is the sole administrator account on the device, the account must stay locked for 1 hour and then automatically unlock.

c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

There are no high availability interfaces which are exempt from unsuccessful logon attempts requirements.

3.3.3 System Use Notification

{For Government 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}

3.3.3.1 System Use Notification for Remote User Interfaces

Remote user interfaces must display a warning banner meeting the

requirements of DTM 08-060 on screen.

3.3.3.2 System Use Notification for Local User Interfaces

Devices which are connected to a network and have a local user interface must display a warning banner meeting the requirements of DTM 08-060 on the user interface screen if capable of doing so and must have a permanently affixed label with an approved banner from DTM 08-060 if unable to display the warning banner on the screen. Where it is impractical (perhaps due to device size) to affix the label to the device, affix the label to the device enclosure.

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.

3.3.4 Session Lock and Session Termination Requirements In MODERATE Impact Systems:

{For Government Reference Only: This subpart (and its subparts) relates to AC-11(a), AC-11(b), AC-11(1), AC-12, SC-10; AC-10; CCI-000058, CCI-000059, CCI-000056, CCI-000057, CCI-000060, CCI-002360, CCI-002361, CCI-001133, CCI-001134, CCI-000054, CCI-000055, CCI-002252}

3.3.4.1 Session Termination

When session termination is required for a User Interface, the User Interface must implement session termination a) based on manual initiation, or b) based on lack of activity, or c) based on either manual initiation or lack of activity, as indicated.

Session Termination must result in logging out the user. A logged out User Interface may only perform actions as indicated in the "Permitted Actions Without Identification or Authentication" subpart of this Section or display a publicly viewable image or blank screen. User Interfaces must remain logged out (session terminated) until a user enters correct authentication information, which must initiate a new session. All User Interfaces running on computers and all Remote User Interfaces must also terminate network connections as part of session termination.

3.3.4.2 Session Lock

When session lock is required for a User Interface, the User Interface must implement session lock based on either manual initiation or lack of activity, as indicated.

Session lock must result in the User Interface being suspended and the user interface must display a publicly viewable image or blank screen. No interaction with the user interface shall be possible until either a) the same user enters valid authentication information, in which case that session must be continued, or b) until a different user enters valid authentication information at which point the first session must be terminated and a new session initiated for the new user.

3.3.4.3 Session Lock and Termination for Computers

User Interface sessions provided by computer operating systems must

support the requirement for both Session Lock and Session Termination. Session Lock and Session Termination must be capable of being initiated by the user and must also be initiated by lack of activity. Session Lock must occur after 15 minutes of inactivity, and Session Termination must occur after 30 minutes total of inactivity (including, not in addition to, the time for Session Lock). When a user initiates a new session, terminate existing sessions if necessary to limit the total number of concurrent sessions to 1.

Other User Interface sessions running on computers (for local user interfaces) or hosted on a computer (for remote user interfaces) and supporting accounts must support user initiation of Session Termination and session lock. Session lock may be initiated by user initiation or automatically after 15 minutes of inactivity. In addition, remote User Interface sessions must also initiate Session Termination after 30 minutes of inactivity .

3.3.4.4 Session Lock and Termination for Controllers

Except as shown in the Session Lock and Session Termination Exception Table, Writable Remote User Interfaces must support requirements for Session Termination, and must both be capable of being initiated by the user and initiated by lack of activity. Session Termination must initiate after 30 minutes of inactivity.

Except as shown in the Session Lock and Session Termination Exception Table, Local User Interfaces supporting accounts must support manual initiation of Session Termination. Privileged Local User Interfaces must also support timed initiation of Session Termination, unless otherwise indicated in the Session Lock and Termination Exceptions table, with Session Termination initiated at 30 minutes of inactivity.They must also support session lock, where session lock may be initiated by user initiation or automatically after 15 minutes of inactivity.

3.3.5 Permitted Actions Without Identification or Authentication

{For Government 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.

3.3.6 Pysical Security in MODERATE Impact Systems

{For Government Reference Only: This subpart relates to PE-3(1), PE-4, PE-5, SC-7(a), SC-7(c), SC-8, SC-8(1); CCI-000928, CCI-002926, CCI-000936, CCI-002930, CCI-002931, CCI-000937, CCI-001097, CCI-001109, CCI-002418, CCI-002419, CCI-002421.}

3.3.6.1 Physical Security for Media

3.3.6.1.1 Physical Security for Media Inside Mission Space

Install all non-IP network media located inside of the mission space in conduit. Install all IP network media located inside of the mission space in intermediate metallic conduit.

3.3.6.1.2 Physical Security for Media Outside Mission Space

Install all network media (both IP and non-IP) located outside of the mission space in rigid metallic conduit.

3.3.6.2 Physical Security for Devices

Install all devices (computers and controllers) which are located outside of mission space in lockable enclosures. (Recall that per definition of mission space, a room controlled by the mission is mission space regardless of whether it is contiguous with other mission space.)

Install all controllers connected to an IP network in lockable enclosures (both inside and outside of mission space).

3.3.6.3 Physical Security for User Interfaces

Physical security requirements for User Interfaces are specified in the preceeding paragraphs of this Section.

3.3.7 Enclosures

Prior to final acceptance of the system, lock all lockable enclosures. Submit an Enclosure Keys submittal with all copies of keys for all enclosures and a key inventory list documenting all keys. Label each key with the matching enclosure identifier.

3.4 USER IDENTIFICATION AND AUTHENTICATION

{For Government Reference Only: This subpart (and its subparts) relates to IA-2, IA-2(1),IA-2(12), IA-5 IA-5(b), IA-5(c), IA-5(e), IA-5(g), IA-5(1), IA-5(11); CCI-000764, CCI-000765, CCI-001953, CCI-001954, 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. For MODERATE Impact systems, this subpart also relates to AC-6 (1), AC-6(10), AC-6(2), AC-6(9)IA-2(4), IA-5(13); CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-000768, CCI-002007.}

This subpart indicates requirements for specific methods of identification and authentication for users and user accounts. Where these requirements conflict apply the following order of precedence: 1) If present, Device Specific Requirements take precedence over any other requirements; and then 2) multifactor authentication requirements take precedence over password requirements.

3.4.1 User Identification and Authentication for All System Types

Unless otherwise indicated, all user interfaces supporting accounts (either FULLY or MINIMALLY) must implement Identification and Authorization via passwords.

For MODERATE Impact Systems:User interfaces supporting accounts (FULLY or MINIMALLY) on computers must implement multifactor authentication via PIV. Devices with Privileged Remote User Interfaces must implement multifactor authentication via PIV. Software running on computers and computer operating systems must manage cached authenticators in accordance

with the relevant STIGs. All other devices and software must not use cached authenticators.

3.4.2 User Identification and Authentication for Specific System Types

System specific requirements are in addition to and supersede those indicated for all system types. When no additional requirements are indicated for a specific system type the requirements for all systems still apply to that system type.

3.4.2.1 Electronic Security System Devices

User interfaces which FULLY support accounts and which run on a computer must use multifactor authentication via PIV. Other user interfaces which FULLY support accounts must use multifactor authentication via PIV. User interfaces which MINIMALLY support accounts must use either passwords or multifactor authentication via PIV.

3.4.3 User Identification and Authentication for Specific Devices

There are no additional device specific user interface requirements

3.4.4 Implementation of Identification and Authorization Requirements

Identification and Authorization must be met by one of the following methods:

a. Direct implementation in the user interface.

b. For user interfaces on a computer: inheriting the Identification and Authorization from the computer operating system, either by the operating system limiting access to specific applications by user, or by the application itself having permissions based on the user logged into the computer.

c. For remote interfaces: an implementation shared between the remote user interface server and the remote user interface client. For example, a requirement for PIV authentication may be met on a remote user interface by a PIV reader on a web browser client which sends the authentication information via HTTPS to the remote server.

3.4.5 Password-Based Authentication Requirements

3.4.5.1 Passwords for Software and Applications Running on Computers

All software and applications running on 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. The list of supported special characters must include at least 4 separate

characters.

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 (where location is significant, a character may be reused if it is in a different position).

i. Passwords must be cryptographically protected during storage and transmission.

3.4.5.2 Passwords for Controllers FULLY Supporting Accounts

All controllers 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. The list of supported special characters must include at least 4 separate characters.

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.

3.4.5.3 Passwords for Remote Interfaces

Passwords for connecting to a Remote User Interface 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. The list of supported special characters must include at least 4 separate characters.

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 (where location is significant, a character may be reused if it is in a different position).

h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.4 Passwords for Devices Minimally Supporting Accounts

Devices MINIMALLY supporting accounts must support passwords with a minimum length of four characters.

3.4.5.5 Password Configuration and Reporting

For all devices with a password, coordinate the changing of passwords with the project site following testing of the system but prior to turnover to the Government. Coordinate with Password Point of Contact to determine appropriate project site personnel to complete password changes. Accompany identified personnel to each device with a password and instruct personnel on the process of changing password. Record the time, date and personnel present when each device's password is changed and submit a Password Change Summary Report documenting this information.

Provide the Password Summary Report electronically in both PDF and Microsoft Excel.

3.4.6 Authenticator Feedback

{For Government 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.

3.4.7 Implementation of PKI Infrastructure in MODERATE Impact Systems

Coordinate with the PKI Infrastructure Point of Contact to configure the system to implement PKI such that the system validates certifications by constructing and verifying a certification path to an accepted trust anchor including checking certificate status information; the system enforces authorized access to the corresponding private key; the system maps the authenticated identity to the account of the individual or group; and the system implements a local cache of revocation data to support path discovery and validation in case of inability to access revocation information via the network.

## 3.5 CYBERSECURITY AUDITING

Where an auditing requirement exists for email notification, notify via email the application administrator and Information System Security Officer (ISSO) of the event. Coordinate with the Email Address Point of Contact for email addresses. If outgoing email is not available to the system, configure the system for these notifications for future support of outgoing email.

### 3.5.1 Audit Events, Content of Audit Records, and Audit Generation

{For Government Reference Only: This subpart (and its subparts) relates to AU-2(a), AU-2(c), AU-2(d), AU-3, AU-10, AU-12, AU-13(3), AU-14(b), AU-14(1), AU-14(2), AU-14(3), CM-5(1), SC-7 (9); CCI-000123, CCI-001571, CCI-000125, CCI-001485, CCI-000130, CCI-000131, CCI-000132, CCI-00133, CCI-000134, CCI-001487, CCI-000166, CCI-001899, CCI-000169, CCI-001459, CCI-000171, CCI-000172, CCI-001910, CCI-001914, CCI-001919, CCI-001464, CCI-001462, CCI-001920, CCI-001814, CCI-002400. For MODERATE Impact systems, this subpart (and its subparts) also relates to AU-3 (1); CCI-000135, CCI-001488}

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.

If auditing requirements can be met using existing control system alarm or event capabilities, those existing capabilities may be used to meet these requirements.

#### 3.5.1.1 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

##### 3.5.1.1.1 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. Successful logouts

d. Privileged activities or other system level access

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.

For MODERATE Impact Systems, also provide email notification when these audit events occur.

j. All kernel module load, unload, and restart

3.5.1.1.2 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
h. For MODERATE Impact Systems: For all privileged commands, full-text recording of the executed command and the user executing the command

For MODERATE Impact Systems: Audit records must provide sufficient detail to reconstruct events to determine cause of compromise and magnitude of damage, malfunction, or security violation.

3.5.1.2 Default Requirements for Control System Controllers

For control system controllers where Audit Events, Content of Audit Records, and Audit Generation are not otherwise indicated in this Section:

3.5.1.2.1 Controllers Which FULLY Support Accounts

For each controller which FULLY supports accounts, provide the capability to select audited events and the content of audit logs. Configure controllers to audit the indicated events, and to record the indicated information for each auditable event.

3.5.1.2.1.1 Audited Events

Configure each controller 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. Successful logouts

d. Concurrent logons from different workstations

e. All account creations, modifications, disabling, and terminations. For MODERATE Impact Systems, also provide email notification when these audit events occur.

f. All kernel module load, unload, and restart

g. For privileged user interfaces in MODERATE Impact Systems: All user commands.

3.5.1.2.1.2 Audit Event Information To Record

Configure each controller 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
g. For privileged user interfaces in MODERATE Impact Systems: Full text recording of the executed command and the user executing the command.

For MODERATE Impact Systems: Audit records must provide sufficient detail to reconstruct events to determine cause of compromise and magnitude of damage, malfunction, or security violation

3.5.1.2.2 Controllers Which Do Not FULLY Support Accounts

For each controller which does not FULLY support accounts configure the controller to audit all controller shutdown and startup events and to record for each event the type of event and when the event occurred.

3.5.2 Audit Time Stamps

{For Government Reference Only: This subpart (and its subparts) relates to AU-8; CCI-000159, CCI-001889, CCI-001890. For MODERATE Impact systems, this subpart (and its subparts) also relates to AU-8 (1); CCI-001891, CCI-001892, CCI-002046.}

Any device (computer or controller) generating audit records must have an internal clock capable of providing time with a resolution of one second. Clocks must not drift more than 10 seconds per day. Configure the system so that each device (computer or controller) generating audit records maintains accurate time to within 1 second. Note that if the control system specifications include requirement for clocks, the most stringent requirement applies.

3.5.3 Auditing Front End Software

The project site currently has the following software to support control system auditing: none. If there is no existing auditing front end software or the software is not compatible with the provided control systems, provide Auditing Front End Software with audit log import and upload, export, notification, and analysis functionality. The Auditing Front End Software may be provided as a component of the control system front end or as a separate software package, and a single package may serve multiple control systems provided under the same projects if they are sharing a cybersecurity authorization.

When the Auditing Front End Software is neither existing nor installed under the requirements of another Section, furnish the Auditing Front End Software media and license for subsequent Government installationand install the software on the control system front end computer. Submit copies of Auditing Front End Software if this function is not part of the software provided with the control system to meet requirements of other Sections.

3.5.3.1 Import and Upload Requirements

Auditing Front End Software must be capable of importing audit logs from the Device Audit Record Upload Software and of uploading audit logs over the network from all control system devices supporting network upload of audit logs.

3.5.3.2 Export Requirements

Auditing Front End Software must be capable of exporting to a file format supported by Microsoft Excel.

3.5.3.3 Notification Of Audit Failure in Devices in MODERATE Impact Systems

The auditing front end software must be capable of receiving notifications of audit failure from control system devices and computers and be able to provide email notification based on receipt of the notification.

3.5.3.4 Audit Reduction and Report Generation In MODERATE Impact Systems

{For Government Reference Only: This subpart (and its subparts) relates to AU-6(4), AU-7(a), AU-7(b), AU-7(1), AU-12(1); CCI-000154, CCI-001875, CCI-001876, CCI-001877, CCI-001878, CCI-001879, CCI-001880, CCI-001881, CCI-001882, CCI-000158, CCI-000173, CCI-000174, CCI-001577.}

Auditing Front End Software must provide audit reduction and reporting capabilities that supports on-demand review and analysis, on demand reporting, and after the fact investigations of security incidents. The software must be able to combine audit records from all components within the system and analyze them as a single audit record. The software must correct for discrepancies in timestamps of audit logs from different sources and be able to account for discrepancies up to 2 seconds between sources. The software must not alter original audit record content or time ordering of audit records. The software must have the capability to filter audit records using user-defined fields within the audit records.

The audit reduction and reporting capabilities may incorporate third party application, such as Excel or Access.

3.5.4 Audit Storage Capacity and Audit Upload

{For Government Reference Only: This subpart (and its subparts) relates to AU-4; CCI-001848, CCI-001849}

The creation of audit records must never interfere with normal device operation. Devices must cease collection of auditing information if required to maintain normal operation.

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.

a. For controllers capable of generating audit records, provide 60 days worth of secure local storage, assuming 10 auditable events per day.

c. For computers, provide storage for at least 20 MB of audit records.

3.5.4.1 Device Audit Record Upload Software

For each device (computer or controller) required to audit events and for which audit logs cannot be uploaded over the network by the Auditing Front End Software, provide and license to the Government software implementing a secure mechanism of uploading audit records from the device and exporting them to the Auditing Front End Software. 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 this function is not part of the software provided with the control system to meet requirements of other Sections. If there are no devices requiring this software, provide a document stating this in lieu of this submittal.

3.5.5 Response to Audit Processing Failures

{For Government Reference Only: This subpart (and its subparts) relates to AU-5; CCI-000139, CCI-000140, CCI-001490.}

In the case of a failure in the auditing system, computers associated with auditing must provide email notification. Impact systems, the computer must also notify the associated auditing front end software. In case of an audit failure, if possible, continue to collect audit records by overwriting existing audit records.

For MODERATE Impact Systems: In the case of an audit failure at a controller performing auditing, the device must notify the associated auditing front end software of the audit failure if able, and must continue to collect audit records by overwriting existing audit records if able. The auditing front end software must provide notification as indicated, treating the notification of failure from the device as a failure in the auditing system.

3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Government Reference Only: This subpart (and its subparts), along with the network communication report submittal specified elsewhere in this section, relates to CM-6(a), CM-6(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 MODERATE Impact systems, this subpart (and its subparts) also relates to CM-7(2), CM-7(5)(a), CM-7(5)(b); CCI-000381, CCI-000380, CCI-00382, CCI-001761, CCI-001762}

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.

3.6.1 Device Capabilities

Do not provide devices with remote user interfaces or full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

Unless specifically required by the government, do not provide a capability to update device firmware over the network.

3.6.2 Software

For software that has a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port access for least functionality), install and configure the software in accordance with that STIG or SRG.

For MODERATE Impact Systems: Do not provide (install) software that is not specifically required to meet a contract requirement. Do not implement functionality within software that is not specifically required to meet contract requirements.

3.7 SYSTEM AND COMMUNICATION PROTECTION

3.7.1 Collaborative Computing

{For Government Reference Only: This subpart relates to SC-15(a), SC-15(b); CCI-001150, CCI-001152.}

Without explicit approval from the project site, control systems must not use collaborative computing technologies.

3.7.2 Denial of Service Protection and Application Partitioning In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-5, SC-39, SC-7(a); CCI-001093, CCI-002385, CCI-002386, CCI-002430, CCI-001097. For MODERATE Impact systems, this subpart also relates to SC-2; CCI-001082.}

To the greatest extent practical, implement control logic without reliance on the network. Except when required to meet the requirements of the control system Section (where the requirement can only be met using computer hardware), do not implement control logic in computers. For MODERATE Impact systems, do not implement control logic in a device providing (i.e. acting as a server for) a Full Remote User Interface.

3.7.2.1 Default Requirements for MODERATE Impact Control Systems

Except for networked input and outputs on input-output buses specifically designed to provide high reliability or redundancy, sensors and actuators must not rely on the network to exchange data with the controller executing the sequence of operation which uses the sensor value or determines the actuator command.

Sensor values required by multiple devices may be shared over the network provided they are connected to a controller requiring the value for execution of the sequence and that controller shares the value on the network.

3.7.3 Mobile Code In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-18(a), SC-18(b), SC-18(c), SC-18(1), SC-18(3), SC-18(4); CCI-001160, CCI-001161, CCI-001162, CCI-001163, CCI-001164, CCI-001165, CCI-001166, CCI-001662, CCI-002457, CCI-002458, CCI-001169, CCI-001695, CCI-001170, CCI-002469}

Devices with STIGs/SRGs related to Mobile Code and to Security Control SC-18 must be installed in accordance with the relevant STIGs/SRGs. All remote user interfaces must meet the requirements of the "Web Browsers and Application SRG".

3.7.4 Protection of Information at Rest In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-28, SC-28(1); CCI-001199,
CCI-002472, CCI-002475, CCI-002476}

Computers must protect information at rest in accordance with applicable STIGs.

Any control system device storing personally identifiable information (PII), controlled unclassified information (CUI), or classified information must be protected by an Information At Rest encryption solution or by a physical security solution. Provide a Protection of Information At Rest Proposal indicating each device storing PII, CUI, or classified information and the encryption or physical security solution proposed for that device for government approval. If no devices stores PII, CUI, or classified information, provide a document stating this as the Protection of Information At Rest Proposal submittal. Do proceed with device selection and installation until the Protection of Information At Rest Proposal is approved. Once approved, implement approved Information At Rest protections.

3.8 SAFE MODE AND FAIL SAFE OPERATION

{For Government Reference Only: This subpart (and its subparts) relates to CP-12, SI-10(3), SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002754, 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.

3.9 SYSTEM MAINTENANCE TOOL SOFTWARE

{For Government Reference Only: This subpart (and its subparts) relates to MA-3; CCI-000865.}

Submit and license to the Government all software required to operate, maintain and modify the control system such 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. Submit hard copies of user manuals for each software with the software submittal.

For software provided and licensed to the Government under the requirements of another Section, submit a statement indicating the Section and Submittal under which the software was provided. For software provided to meet the requirements of this Section and not

provided and licensed under another Section, submit software and software user manuals on DVD or CD as a Technical Data Package and submit two hard copies of the software user manual for each piece of software.

3.10 DEVICE POWER

{For Government Reference Only: This subpart (and its subparts) relates to PE-11, PE-11(1); CCI-002955, CCI-000961. For MODERATE Impact systems, this subpart (and its subparts) also relates to PE-9, PE-9(1); CCI-000952, CCI-002953, CCI-002954.}

For MODERATE Impact Systems: Provide control system with power supply meeting or exceeding the reliability of the controlled equipment. Powering control system devices using the same power source as the equipment controlled by the device is a permissible method of meeting this requirement. Without explicit approval from the government, do not install local uninterruptible power supplies (UPSs) as a source of device power.

3.10.1 Device Behavior on Loss of Power In MODERATE Impact Systems:

Application programs and configuration settings must be stored in devices in manner such that a loss of power does not result in a loss of the application program or configuration settings: Loss of power must never result in the loss of application programs, regardless of the length of time power is lost; and loss of power for less than 2,500 hours must not result in the loss of configured settings.

In the event of a loss of power, when power is restored, controllers and computers executing control logic (and the underlying equipment) must recover and resume their normal sequences of operation. Note that the sequence of operation may require specific actions (e.g. startup sequences) upon recovery from loss of power.

3.11 VULNERABILITY SCANNING

{For Government Reference Only: This subpart (and its subparts) relates to RA-5 RA-5(a),RA-5(b),RA-5(c),RA-5(d); CCI-001054, CCI-001055, CCI-000156, CCI-001641, CCI-001643, CCI-001057, CCI-001058, CCI-001059. For MODERATE Impact systems, this subpart (and its subparts) also relates to RA-5(1), RA-5(5); CCI-001062, CCI-001067, CCI-001645, CCI-002906.}

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.

3.11.1 Computers and Software Running on Computers

Computers and applications running on computers must meet relevant vulnerability scanning STIGs/SRGs and respond to approved DoD vulnerability scanning tools.

3.11.2 Controllers

Controllers shall be scannable by standard control system discovery tools or control system browsers and return meaningful status information including the network inputs and outputs for the controller. This information shall contain sufficient detail to detect vulnerabilities or

exploits of the controller.

Provide all software needed to scan the control system as the Control System Scanning Tools submittal. If the software required to scan the system is already installed at the project site or is provided under a separate section instead provide a statement indicating this.

3.12 FIPS 201-2 REQUIREMENT

{For Government Reference Only: This subpart (and its subparts) relates to SA-4 (10); CCI-003116}

Devices in the following systems which implement PIV must be on the NIST FIPS 201-2 approved product list ( https://www.idmanagement.gov/approved-products-list/): electronic security systems(ESS).

3.13 SYSTEM AND INTEGRATION INTEGRITY

3.13.1 Malicious Code Protection

{For Government Reference Only: This subpart (and its subparts) relates to SI-3(c); CCI-001241, CCI-002623}

For all computers and devices installed under this project, provide malware protection software media, provide licenses, and install and configure malware protection software as indicated. Coordinate with the Government Computer Access Point of Contact as required.

a. Malware protection software licenses will be Government furnished.

b. Malware protection software media will be Government furnished.

c. Malware protection software will be Government installed.

3.13.2 Software, Firmware, and Information Integrity In MODERATE Impact Systems:

If there exists Integrity Verification Software that can check software, firmware, or information in the control system and verify its integrity, provide it. If no such software exists provide a statement to this affect in lieu of the software.

3.14 CONTROL SYSTEM CYBERSECURITY TESTING

{For Government Reference Only: For MODERATE Impact systems, this subpart (and its subparts) relates to SA-11(a), SA-11(b), SA-11(c), SA-11(d), SA-11(e); CCI-003171, CCI-003172, CCI-003173, CCI-003174, CCI-003175, CCI-003176, CCI-003177, CCI-003178.}

3.15 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT

In addition to testing and testing support required by other Sections, provide a minimum of 40 hours of technical support for cybersecurity testing of control systems to support the DoD Risk Management Framework process Cybersecurity assessment of the control system. This support is independent of (and in addition to) the Control System Cybersecurity

Testing specified in this section.

## 3.16 CYBERSECURITY TRAINING

Provide eight hours of classroom and hands-on training for six Government personnel on the cybersecurity operation and maintenance of the control system provided. This training is in addition to and must be coordinated with control system training specified in other Sections.

The Government will provide the training location. Training must cover, at a minimum: (a) applying software and firmware updates, (b) user account creation, modification and deletion, (c) audit log upload procedures and (d) identification of privileged user interfaces and system impact of those interfaces. Training session must include a question and answer period during which government staff questions about cybersecurity aspects of the control system are answered.

-- End of Section --

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SECTION 25 10 10

ENERGY MONITORING AND CONTROL SYSTEM (EMCS) FRONT END AND INTEGRATION
**02/19**

PART 1 GENERAL

1.1 SUMMARY

Integrate new building systems into the existing Energy Monitoring and Control System (EMCS) which performs supervisory monitoring and supervisory control of building control systems and utility control systems using ASHRAE 135 (BACnet). Integrate ASHRAE 135 (BACnet) field control systems installed per Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS as specified.

1.1.1 System Requirements

Provide a EMCS as specified and indicated, and in accordance with the following characteristics:

1.1.1.1 Compatibility

Provide systems compatible Honeywell Comfort Point Open Studio BACnet in order to integrate into Ellsworth's Honeywell EBI R500 or newer front end.

1.1.1.2 General System Requirements

a. The system shall be integrated into the Base wide system. Integration shall provide full read and write capabilities from the base system on all of the data points to be monitored. Integration shall be performed by the Contractor.

b. The system performs supervisory monitoring and control functions including but not limited to Scheduling, Alarm Handling, Trending, Overrides, Report Generation, and Electrical Demand Limiting as specified.

c. The system includes a Graphical User Interface which allows for graphical navigation between systems, graphical representations of systems, access to real-time data for systems, ability to override points in a system, and access to all supervisory monitoring and control functions.

d. All software used by the EMCS and all software used to install and configure the EMCS is licensed to and delivered to the installation. All licensing costs shall be included by the Contractor, including costs to add points to the base system.

e. Programming software must be provided and be able to integrate with the Base Control Shops laptop computers with an USAF Windows 10 operating system and not conflict with software from other manufacturers, including Honeywell software operating on the same laptop.

f. All necessary documentation, configuration information, configuration

tools, programs, drivers, and other software is licensed to and otherwise remains with the Government such that the Government or their agents are able to repair, replace, upgrade, and expand the system without subsequent or future dependence on the Contractor. Software licenses must not require periodic fees and must be valid in perpetuity.

g. Provide sufficient documentation and data, including rights to documentation and data, such that the Government or their agents can execute work to repair, replace, upgrade, and expand the system without subsequent or future dependence on the Contractor.

h. The EMCS interfaces directly to ASHRAE 135, CEA-709.1-D, MODBUS Protocol, MODBUS TCP/IP, OPC DA, and Niagara Framework field control systems as specified and may interface to field control systems using other protocols via an M&C Software protocol driver or a Gateway.

i. For EMCS systems with Monitoring and Control Software functionality implemented in Monitoring and Control (M&C) Controller Hardware, provide sufficient additional controller hardware to support the full capacity requirements as specified.

1.1.1.3 BACnet Requirements

a. The EMCS must communicate using ASHRAE 135 Annex J over an IP network as specified.

b. All communication between the EMCS and ASHRAE 135 field control networks must be via the ASHRAE 135 protocol over the IP network.

c. All communication between the M&C Software and the field control system devices must be via standard ASHRAE 135 services other than PrivateTransfer and ConfirmedPrivateTransfer except as follows:

(1) PrivateTransfer and ConfirmedPrivateTransfer may be used for device configuration and device programming.

(2) PrivateTransfer and ConfirmedPrivateTransfer may be used for communication between the M&C Software and the field control system if and only if both the M&C Software and the field control system devices automatically (without requiring reconfiguration) revert to the use of other standard ASHRAE 135 services when one of the components is modified or replaced.

1.1.2 General Cybersecurity Requirements

Address cybersecurity in accordance with AF ETL 11-1 and Section 25 05 11.01 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT CONTROL SYSTEM (EMCS) BUILDING LEVEL ONLY.

1.1.3 Symbols, Definition and Abbreviations

Use symbols, definitions, and engineering unit abbreviations indicated in the contract drawings for displays, submittals and reports. For symbols, definitions and abbreviations not in the contract drawings use terms conforming at a minimum to IEEE Stds Dictionary and the ASHRAE FUN IP, as applicable.

1.1.4 System Units and Accuracy

Use English (inch-pound) units for displays, print-outs and calculations. Perform calculations with an accuracy of at least three significant figures. For displays and printouts present values to at least three significant figures.

1.1.5 Data Packages/Submittals Requirements

Technical data packages consisting of computer software and technical data (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 must be delivered with unrestricted rights.

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 | (2020; Errata 2021) BACnet—A Data Communication Protocol for Building Automation and Control Networks |
| ASHRAE FUN IP | (2017) Fundamentals Handbook, I-P Edition |

CONSUMER ELECTRONICS ASSOCIATION (CEA)

| | |
|---|---|
| CEA-709.1-D | (2014) Control Network Protocol Specification |
| CEA-852-C | (2014) Tunneling Device Area Network Protocols Over Internet Protocol Channels |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE C62.41 | (1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits |
| IEEE Stds Dictionary | (2009) IEEE Standards Dictionary: Glossary of Terms & Definitions |

MODBUS ORGANIZATION, INC (MODBUS)

| | |
|---|---|
| MODBUS Protocol | (2012) Modbus Application Protocol Specification; Version 1.1b3 |
| MODBUS TCP/IP | (2006) Modbus Messaging on TCP/IP |

| | |
|---|---|
| | Implementation Guide; Version V1.0b |

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 262 | (2019) Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces |

OPC FOUNDATION (OPC)

| | |
|---|---|
| OPC DA | (Ver 3.0; Errata) OPC Data Access (DA) |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA-568-C.1 | (2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard |
| TIA-606 | (2017c) Administration Standard for the Telecommunications Infrastructure |
| TIA-607 | (2015c; Addendum 1 2017) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises |

TRIDIUM, INC (TRIDIUM)

| | |
|---|---|
| Niagara Framework | (2012) NiagaraAX User's Guide |

U.S. AIR FORCE (USAF)

| | |
|---|---|
| AF ETL 11-1 | (2011) Civil Engineer Industrial Control System Information Assurance Compliance |

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

| | |
|---|---|
| FCC EMC | (2002) FCC Electromagnetic Compliance Requirements |
| FCC Part 15 | Radio Frequency Devices (47 CFR 15) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 60950 | (2000; Reprint Oct 2007) Safety of Information Technology Equipment |

## 1.3 DEFINITIONS

The following list of definitions may contain terms not found elsewhere in this Section but are included here for completeness. Some terms are followed with a protocol reference in parenthesis indicating to which protocol the term and definition applies. Inclusion of protocol-specific definitions does not create a requirement to support that protocol, nor does it relax any requirements to support specific protocols as indicated elsewhere in this section.

1.3.1 Alarm Generation

The process of comparing a point value (the point being alarmed) with a pre-defined alarm condition (e.g., a High Limit) and performing some action based on the result of the comparison.

1.3.2 Alarm Handling

See Alarm Routing.

1.3.3 Alarm Routing

Alarm routing is M&C software functionality that starts with a notification that an alarm exists (typically as the output of an Alarm Generation process) and sends a specific message to a specific alarm recipient or device.

1.3.4 Application Generic Controller (AGC)(LonWorks)

A device that is furnished with a (limited) pre-established application that also has the capability of being programmed. Further, the ProgramID and XIF file of the device are fixed. The programming capability of an AGC may be less flexible than that of a General Purpose Programmable Controller (GPPC).

1.3.5 Application Specific Controller (ASC)(LonWorks)

A device that is furnished with a pre-established built in application that is configurable but not re-programmable. An ASC has a fixed factory-installed application program (i.e., Program ID) with configurable settings.

1.3.6 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.

1.3.7 BACnet Advanced Application Controller (B-AAC)(BACnet)

A hardware device BTL Listed as a B-AAC. A control device which contains BIBBs in support of scheduling and alarming but otherwise has limited resources relative to a B-BC. It may be intended for specific applications and supports some degree of programmability.

1.3.8 BACnet Advanced Operator Workstation (B-AWS)(BACnet)

Monitoring and Control (M&C) Software BTL Listed as an Advanced Operator Workstation and includes the ability to manage scheduling, alarming and trending in an open manner. The B-AWS is the advanced operator's window into a BACnet system. It is primarily used to monitor the performance of a system and to modify parameters that affect the operation of a system.

1.3.9 BACnet Application Specific Controller (B-ASC)(BACnet)

A hardware device BTL Listed as a B-ASC. A controller with limited resources relative to a B-AAC. It is intended for use in a specific

application and supports limited programmability.

1.3.10 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.

1.3.11 BACnet Internetwork (BACnet)

Two or more BACnet networks connected with BACnet routers. In a BACnet Internetwork, there exists only one message path between devices.

1.3.12 BACnet Interoperability Building Blocks (BIBBs) (BACnet)

A BIBB is a collection of one or more BACnet 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 an M&C client, 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.

1.3.13 BACnet Operator Display (B-OD)(BACnet)

A hardware device BTL Listed as a B-OD. A basic operator interface with limited capabilities relative to a B-OWS. It is not intended to perform direct digital control. The B-OD profile could be used for wall-mounted LCD devices, displays affixed to BACnet devices; hand-held terminals or other very simple user interfaces.

1.3.14 BACnet Operator Workstation (B-OWS)(BACnet)

Monitoring and Control (M&C) Software BTL Listed as a B-OWS. An operator interface with limited capabilities relative to a B-AWS. The B-OWS is used for monitoring and basic control of a system, but differs from a B-AWS in that it does not support configuration activities, nor does it provide advanced troubleshooting capabilities.

1.3.15 BACnet Smart Actuator (B-SA)(BACnet)

A hardware device BTL Listed as a B-SA. A simple control output device with limited resources; it is intended for specific applications.

1.3.16 BACnet Smart Sensor (B-SS)(BACnet)

A hardware device BTL Listed as a B-SS. A simple sensing device with very limited resources.

1.3.17 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.

1.3.18 BACnet Testing Laboratories (BTL) Listed (BACnet)

A device that has been certified by BACnet® Testing Laboratory. Devices may be certified to a specific device profile, in which case the certification indicates that the device supports the required capabilities for that profile, or may be certified as "other".

1.3.19 Binary

A two-state system or signal; for example one 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'.

1.3.20 Broadcast

Unlike most messages, which are intended for a specific recipient device, a broadcast message is intended for all devices on the network.

1.3.21 Building Control Network (BCN)

The network used by the Building Control System. Typically the BCN is a BACnet ASHRAE 135 or LonWorks CEA-709.1-D network installed by the building control system contractor.

1.3.22 Building Control System (BCS)

One type of Field Control System. A control system for building electrical and mechanical systems, typically HVAC (including central plants) and lighting. A BCS generally uses Direct Digital Control (DDC) Hardware and generally does NOT include its own local front end.

1.3.23 Building Point of Connection (BPOC)

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).

1.3.24 Commandable (BACnet)

A point (Object) is commandable if its Present_Value Property is writable and it supports the optional Priority_Array Property. This functionality is useful for Overrides.

1.3.25 Configuration Property (LonWorks)

Controller parameter used by the application which is usually set during installation/testing and seldom changed. For example, the P and I settings of a P-I control loop. Also see 'Standard Configuration Property Type (SCPT)'.

1.3.26 Control Logic Diagram

A graphical representation of control logic for multiple processes that make up a system.

1.3.27 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.

1.3.28 Explicit Messaging (LonWorks)

A non-standard and often vendor (application) specific method of communication between devices.

1.3.29 Field Point Of Connection (FPOC)

The FPOC is part of the EMCS IP network and acts as the point of connection between the EMCS IP Network and the field control IP network. The FPOC is an IT device such as a switch, IP router, or firewall, typically managed by the site IT staff. (Note that the field control IP network may consist of a single IP device, or that integration may require installation of a field control network IP device.)

1.3.30 Field Control Network

The network used by a field control system.

1.3.31 Field Control System (FCS)

A building control system or utility control system.

1.3.32 Fox Protocol (Niagara Framework)

The protocol used for communication between components in the Niagara Framework. By default, Fox uses TCP port 1911.

1.3.33 Gateway

A device that translates from one protocol to another. Devices that change only the transport mechanism of the protocol - "translating" from LonWorks over TP/FT-10 to LonWorks over IP for example - are not gateways as the underlying protocol (data format) does not change. Gateways are also called Communications Bridges or Protocol Translators.

1.3.34 General Purpose Programmable Controller (GPPC) (LonWorks)

Unlike an ASC or AGC, a GPPC is not furnished with a fixed application program and does not have a fixed ProgramID or XIF file. A GPPC can be (re-)programmed, usually using vendor-supplied software. When a change to the program affects the external interface (and the XIF file) the ProgramID will change.

1.3.35 Internetwork (BACnet)

See BACnet Internetwork.

1.3.36 JACE (Niagara Framework)

Java Application Control Engine. See Niagara Framework Supervisory Gateway.

1.3.37 LonWorks (LonWorks)

The term used to refer to the overall technology related to the CEA-709.1-D protocol (sometimes called "LonTalk"), including the protocol itself, network management, interoperability guidelines and products.

1.3.38 Modbus

A basic protocol for control network communications generally used in utility control systems. The Modbus protocol standard is maintained by The Modbus Organization.

1.3.39 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.

1.3.40 Monitoring and Control (M&C) Software

The EMCS '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.

1.3.41 Network (BACnet)

In BACnet, a portion of the control internetwork consisting of one or more segments of the same media connected by repeaters. Networks are separated by routers.

1.3.42 Network Variable (LonWorks)

See 'Standard Network Variable Type (SNVT)'.

1.3.43 Network Configuration Tool (LonWorks)

The software used to configure the control network and set device configuration properties. This software creates and modifies the control network database (LNS Database).

1.3.44 Niagara Framework

A set of hardware and software specifications for building and utility control owned by Tridium Inc. and licensed to multiple vendors. The Framework consists of front end (M&C) software, web based clients, field level control hardware, and engineering tools. While the Niagara Framework is not adopted by a recognized standards body and does not use an open licensing model, it is sufficiently well-supported by multiple HVAC vendors to be considered a de-facto Open Standard.

1.3.45 Niagara Framework Supervisory Gateway (Niagara Framework)

DDC Hardware component of the Niagara Framework. A typical Niagara architecture has Niagara specific supervisory gateways at the IP level and

other (non-Niagara specific) controllers on field networks (TP/FT-10, MS/TP, etc.) beneath the Niagara supervisory gateways. The Niagara specific controllers function as a gateway between the Niagara framework protocol (Fox) and the field network beneath. These supervisory gateways may also be used as general purpose controllers and also have the capability to provide a web-browser based user interface.

Note that different vendors refer to this component by different names. The most common name is "JACE"; other names include "EC-BOS", "FX-40", and "UNC".

1.3.46 Node (LonWorks)

A device that communicates using the CEA-709.1-D protocol and is connected to a CEA-709.1-D network.

1.3.47 Object (BACnet)

A BACnet Object. The concept of organizing BACnet information into standard components with various associated Properties. Examples include Analog Input objects and Binary Output objects.

1.3.48 Override

To change the value of a point outside of the normal sequence of operation where this change has priority over the sequence. An override can be accomplished in one of two ways: The point itself may be Commandable and written to with a priority or there may be a separate point on the controller for the express purpose of implementing the override.

Typically this override is from the Energy Monitoring and Control System (EMCS) Monitoring and Control (M&C) Software. Note that this definition is not standard throughout industry.

1.3.49 Point, Calculated

A value within the M&C Software that is not a network point but has been calculated by logic within the software based on the value of network points or other calculated points. Calculated points are sometimes called virtual points or internal points.

1.3.50 Point, Network

A value that the M&C Software reads from or writes to a field control network.

1.3.51 Polling

A requested transmission of data between devices, rather than an unrequested transmission such as Change-Of-Value (COV) or Binding where data is automatically transmitted under certain conditions.

1.3.52 Program ID (LonWorks)

An identifier (number) stored in the device (usually EEPROM) that identifies the node manufacturer, functionality of device (application & sequence), transceiver used, and intended device usage.

1.3.53 Property (BACnet)

A BACnet Property - a data element associated with an Object. Different Objects have different Properties, for example an Analog Input Object has a Present_Value Property (which provides the value of the underlying hardware analog input), a High_Limit Property (which contains a high limit for alarming), as well as other properties.

1.3.54 Protocol Implementation Conformance Statement (PICS)(BACnet)

A document, created by the manufacturer of a device, which describes which potions of the BACnet standard are implemented by a given device.

1.3.55 Repeater

A device that connects two control network segments and retransmits all information received on one side onto the other.

1.3.56 Router (BACnet)

A device that connects two or more BACnet networks and controls traffic between the networks by retransmitting signals received from one network onto another based on the signal destination. Routers are used to subdivide an internetwork and to control bandwidth usage.

1.3.57 Segment

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. For example, a TP/FT-10 segment with locally powered devices is limited to 64 devices, and a BACnet MS/TP segment is limited to 32 devices.

1.3.58 Service (BACnet)

A BACnet Service. A defined method for sending a specific type of data between devices. Services are always defined in a Client-Server manner, with a Client initiating a Service request and a Server Executing the Service. Some examples are ReadProperty (a client requests a data value from a server), WriteProperty (a client writes a data value to a server), and CreateObject (a client requests that a server create a new object within the server device).

1.3.59 Standard BACnet Object/Property/Service (BACnet)

BACnet Objects, Properties, or Services that are standard Objects, Properties, or Services enumerated and defined in ASHRAE 135. Clause 23 of ASHRAE 135 defines methods to extend ASHRAE 135 to non-standard or proprietary information. Standard BACnet Objects/Properties/Services specifically exclude any vendor specific extensions.

1.3.60 Standard Network Variable Type (SNVT) (LonWorks)

Pronounced 'snivet'. A standard format type (maintained by LonMark International) used to define data information transmitted and received by the individual nodes. The term SNVT is used in two ways. Technically it is the acronym for Standard Network Variable Type, and is sometimes used in this manner. However, it is often used to indicate the network variable itself (i.e., it can mean "a network variable of a standard

network variable type"). In general, the intended meaning should be clear from the context.

1.3.61 Supervisory Controller

A controller implementing a combination of supervisory logic (global control strategies or optimization strategies), scheduling, alarming, event management, trending, web services or network management. Note this is defined by use; many supervisory controllers have the capability to also directly control equipment.

1.3.62 Supervisory Gateway

A device that is both a supervisory controller and a gateway.

1.3.63 EMCS Network

An IP network connecting multiple field control systems to the Monitoring and Control Software using one or more of: LonWorks (CEA-709.1-D and CEA-852-C), BACnet (ASHRAE 135 Annex J), MODBUS Protocol, MODBUS TCP/IP or OPC DA.

1.3.64 Utility Control System (UCS)

One type of field control system. Used for control of utility systems such as an electrical substation, sanitary sewer lift station, water pump station, etc. Building controls are excluded from a UCS, however it is possible to have a Utility Control System and a Building Control System in the same facility, and for those systems to share components such as the FPOC. A UCS may include its own local front-end.

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. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES and TABLE 1. PROJECT SEQUENCING:

SD-02 Shop Drawings

EMCS Contractor Design Drawings; G, AE

EMCS Contractor Design Drawings as a single complete package: 2 hard copies and 1 copy on CDROM. Submit hardcopy drawings on ISO A1 34 by 22 inches or A3 17 by 11 inches sheets, and electronic drawings in both PDF and AutoCAD format.

Draft As-Built Drawings; G RO

Draft As-Built Drawings as a single complete package: 2 hard copies and 1 copy on CDROM. Submit hardcopy drawings must on ISO A1 34 by 22 inches or A3 17 by 11 inches sheets, and electronic drawings in both PDF and AutoCAD format.

Final As-Built Drawings; G RO

Final As-Built Drawings as a single complete package: 2 hard

copies and 1 copy on CDROM. Submit hardcopy drawings on ISO A1 34 by 22 inches or A3 17 by 11 inches sheets, and electronic drawings in both PDF and AutoCAD format.

SD-03 Product Data

Product Data Sheets; G, AE

Computer Software; G RO

The most recent versions of all computer software provided under this specification delivered as a Technical Data Package. Submit the user manuals for all software delivered for this project with the software.

Enclosure Keys

SD-05 Design Data

EMCS IP Network Bandwidth Usage Estimate

Four copies of the EMCS IP Network Bandwidth Usage Estimate.

SD-06 Test Reports

Pre-Construction QC Checklist; G RO

Four copies of the Pre-Construction QC Checklist.

Post-Construction QC Checklist; G RO

Four copies of the Post-Construction QC Checklist.

PVT Phase I Procedures; G RO

Four copies of the PVT Phase I Procedures. The PVT Procedures may be submitted as a Technical Data Package.

PVT Phase I Report; G RO

Four copies of the PVT Phase I Report. The PVT Phase I Report may be submitted as a Technical Data Package.

PVT Phase II Report; G RO

Four copies of the PVT Phase II Report. The PVT Phase II Report may be submitted as a Technical Data Package.

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G RO

Four bound O&M Instructions and 1 copy of the Instructions in PDF format on optical disc. Index and tab bound instructions. Submit instructions in PDF form as a single PDF file, or as multiple PDF files with a PDF file table of contents containing links to the other files. O&M Instructions may be submitted as a Technical Data Package.

Preventive Maintenance Work Plan; G RO

Four copies of the Preventive Maintenance Work Plan. The Preventive Maintenance Work Plan may be submitted as a Technical Data Package.

Basic Training Documentation; G RO

Training manuals for Basic Training delivered for each trainee on the Course Attendance List with two additional copies delivered for archival at the project site. Submit two copies of the Course Attendance List with the archival copies. The Basic Training Documentation may be submitted as a Technical Data Package.

Advanced Training Documentation; G RO

One set of training manuals delivered for each trainee on the Course Attendance List with two additional copies delivered for archival at the project site. Submit two copies of the Course Attendance List with the archival copies. The Advanced Training Documentation may be submitted as a Technical Data Package.

Refresher Training Documentation; G RO

One set of training manuals delivered for each trainee on the Course Attendance List with two additional copies delivered for archival at the project site. Submit two copies of the Course Attendance List with the archival copies. The Refresher Training Documentation may be submitted as a Technical Data Package.

SD-11 Closeout Submittals

Closeout QC Checklist; G RO

Four copies of the Closeout QC Checklist.

## 1.5 PROJECT SEQUENCING

TABLE I. PROJECT SEQUENCING specifies 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).

### 1.5.1 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 re-submittal 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.

### 1.5.2 Sequencing for Activities

The sequencing specified for activities indicates the earliest the activity may begin.

1.5.3 Abbreviations

In TABLE I the abbreviation AAO is used for 'after approval of' and 'ACO' is used for 'after completion of'.

TABLE I. PROJECT SEQUENCING

| ITEM | TYPE | DESCRIPTION | SEQUENCING (START OF ACTIVITY or DEADLINE FOR SUBMITTAL) |
|---|---|---|---|
| 1 | | Notice to proceed | |
| 3 | S | Design Drawings | after #1 |
| 4 | S | Product Data Sheets | after #1 |
| 5 | S | EMCS IP Network Bandwidth Usage Estimate | after #1 |
| 6 | S | Pre-construction QC Checklist | after #1 |
| 7 | E | Install EMCS | AAO #2 thru #6 |
| 8 | E | Start-Up and Start-Up Testing | ACO #7 |
| 9 | S | Post-Construction QC Checklist | ACO #8 |
| 10 | S | Computer Software | ACO #8 |
| 11 | S | Start-Up and Start-Up Testing Report | ACO #8 |
| 12 | S | Draft As-Built Drawings | ACO #8 |
| 13 | S | PVT Phase I Procedures | before scheduled start of #14 and AAO #11 |
| 14 | E | PVT Phase I | AAO #13 and #12 |
| 15 | S | PVT Phase I Report | ACO #14 |
| 16 | S | Preventive Maintenance Work Plan | AAO #11 |

TABLE I. PROJECT SEQUENCING

| ITEM | TYPE | DESCRIPTION | SEQUENCING (START OF ACTIVITY or DEADLINE FOR SUBMITTAL) |
|---|---|---|---|
| 17 | S | O&M Instructions | AAO #11 |
| 18 | S | Basic Training Documentation | AAO #11 and before scheduled start of #19 |
| 19 | E | Basic Training (PVT Phase II) | AAO #16, #17 and #18 |
| 20 | S | PVT Phase II Report | ACO #19 |
| 21 | S | Final As-Built Drawings | AAO #20 |
| 22 | S | Advanced Training Documentation | before schedule start of #23 and AAO #18 |
| 23 | E | Advanced Training | ACO #19, AAO #22, and no later than 60 days ACO #19 |
| 24 | S | Refresher Training Documentation | before #25 and AAO #18 and #22 |
| 25 | E | Refresher Training | ACO #19 and AAO #24 |
| 26 | S | Closeout QC Checklist | ACO #23 |

## 1.6 QUALITY CONTROL (QC) CHECKLISTS

The Contractor's Chief Quality Control (QC) Representative must complete the QC Checklist in APPENDIX A, and must submit the Pre-Construction QC Checklist, Post-Construction QC Checklist and Closeout QC Checklist as specified. The QC Representative must verify each item in the Checklist and initial in the provided area to indicate that the requirement has been met. The QC Representative must sign and date the Checklist prior to submission to the Government.

The APPENDIX A QC Checklist is available as an editable file at http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-10-10.

## 1.7 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Provide EMCS Operation and Maintenance Instructions which include:

a. Procedures for the EMCS system start-up, operation and shut-down.

b. Final As-Built drawings.

c. Routine maintenance checklist, arranged in a columnar format: The first column listing all installed devices, the second column stating the maintenance activity or stating that no maintenance required, the third column stating the frequency of the maintenance activity, and the fourth column providing any additional comments or reference.

d. Qualified service organization list including points of contact with phone numbers.

e. Start-Up and Start-Up Testing Report.

f. Performance Verification Test (PVT) Procedures and Reports.

PART 2 PRODUCTS

2.1 EQUIPMENT REQUIREMENTS

2.1.1 Product Certifications

For computing devices, as defined in FCC Part 15, supplied as part of the EMCS provide devices which are certified to comply with the requirements of Class B computing devices.

2.1.2 Product Sourcing

For units of the same type of equipment, provide products of a single manufacturer. For each major component of equipment provide equipment with the manufacturer's name and the model and serial number in a conspicuous place. For materials and equipment, provide new standard unmodified products of a manufacturer regularly engaged in the manufacturing of such products.

2.1.3 General Requirements

Provide components that meet the following requirements:

a. Portions of the data communications equipment system installed in unconditioned spaces must operate properly in an environment with ambient temperatures between 32 and 120 degrees F and ambient relative humidity between 10 percent and 90 percent noncondensing.

b. Components must accept 100 to 125 volts AC (Vac), 60 Hz, single phase, three wire with a three-pronged, dedicated circuit outlet or be provided with a transformer to meet the component's power requirements.

c. The equipment must meet the requirements of NFPA 70, UL 60950, NFPA 262, FCC EMC, and FCC Part 15.

2.1.4 Nameplates

Provide nameplates of laminated plastic identifying the function, network address, if applicable, and identifier of the device. Laminated plastic must be at least 0.125 inch thick, white with black center core. Nameplates must be a minimum of 1 by 3 inch with minimum 0.25 inch high engraved block lettering.

2.1.5 Product Data Sheets

For all products (equipment) specified in PART 2 and supplied under this

contract, submit copies of all manufacturer catalog cuts and specification sheets to indicate conformance to product requirements. For Monitoring and Control (M&C) Software also include the PICS verifying BTL Listing as a B-AWS.

## 2.2 CONTROL HARDWARE

### 2.2.1 Control Protocol Routers

#### 2.2.1.1 BACnet/IP Router

Provide BACnet/IP Routers which 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 a ASHRAE 135 MS/TP network. Devices used as BACnet/IP Routers must be BTL Listed and must support the Network Management-Router Configuration-B (NM-RC-B) BIBB.

## 2.3 COMPUTER SOFTWARE

### 2.3.1 Monitoring and Control (M&C) Software

The existing monitoring and control (M&C) software communicates via Honeywell Comfort Point Open Studio BACnet. Verify that the software meets the specifications in this section. Notify the Government if modifications are required and gain written approval prior to making such modifications.

Contractor shall integrate the new building control system including set up of the Scheduling, Alarming, Trending, Graphical System Display, and System Display Editor functionality. Other specified M&C functionality may be implemented in the same software package or in additional software packages. As specified in PART 3 EXECUTION, the M&C Software must operate on Server hardware, except that software for Point Calculations and Demand Limiting may operate on M&C Controller Hardware.

#### 2.3.1.1 M&C Software License

License the M&C Software as specified. Use of multiple copies of M&C Server software working in coordination and sharing data between them such that they function as, and appear to an operator as, a single M&C Server is permitted to meet these requirements.

##### 2.3.1.1.1 Network Points

Provide M&C Software and licensing to support no less than 50,000 network points, and to be capable of expansion.

##### 2.3.1.1.2 Web Clients

Provide M&C Software and licensing to support no less than 10 simultaneous web clients with no limit on the total number of web clients. M&C Software must be capable of expansion to support no less than 30 simultaneous web clients.

##### 2.3.1.1.3 Calculations

Provide M&C Software and licensing to support no less than one calculated point for every ten network points (see "Network Points" above).

2.3.1.1.4 Other Points

For installations using M&C Software installed on M&C Controller Hardware (as opposed to Server hardware), provide additional licensing to support additional network points for the communications between portions of the M&C Software installed on different hardware. For example, if the Calculations requirement is performed by M&C Software installed on Controller hardware, the M&C Software must be licensed for additional network points to cover the network points required for communication between the Controller hardware and the Server hardware.

2.3.1.1.5 Alarming

Provide M&C Software and licensing to support the handling (routing) of alarms for no less than 10,000 ASHRAE 135 Alarm Event Notifications.

2.3.1.1.6 Trending

Provide M&C Software and licensing to support a minimum of 8,000 simultaneous trends.

2.3.1.2 M&C Software Update Licensing

In addition to all other licensing requirements, provide M&C Software licensing which includes licensing of the following software updates for a period of no less than 5 years:

a. Security and bug-fix patches issued by the M&C 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.

2.3.1.3 Point Information

Every point, both network and internal, in the M&C Software must contain the following fields:

2.3.1.3.1 Name

A configurable name used for identification of the point within the M&C Software.

2.3.1.3.2 Description

A configurable description of no less than 80 alpha-numeric characters.

2.3.1.3.3 Value

A field containing the current point value.

2.3.1.3.4 Units

A field containing the engineering units.

2.3.1.3.5 Source

A field identifying the source of the point. For network points, this is generally the address or identification of the field device (for example, the Domain-Subnet-Node address for LonWorks field control devices or the DeviceID for BACnet devices).

2.3.1.4 Passwords

Provide M&C software with user-based access control to M&C functionality. The M&C Software must recognize at least 100 separate users and have at least 4 levels of user permissions. User permission levels (from most restrictive to most permissive) must include:

a. Permission Level 1: View-only access to the graphical user interface.

b. Permission Level 2: Permission Level 1 plus acknowledge alarms and set up (configure) trends and reports.

c. Permission Level 3: Permission Level 2 plus override points and set up (configure) alarms, schedules and demand limiting.

d. Permission Level 4: Permission Level 3 plus create and modify Graphical System Displays using the System Display Editor.

Passwords must not be displayed and must not be logged. The system must maintain a disk file on the server hardware logging all activity of the system. This file must maintain, as a minimum, a record of all operators logged onto the system, alarm acknowledgments, commands issued and all database modifications. If the file format is not plain ASCII text, provide a means to export or convert the file to plain ASCII text. Provide a mechanism for archiving the log files for long term record storage.

2.3.1.5 Graphical System Displays

Provide graphical displays consisting of building system (air handler units, VAV boxes, chillers, cooling towers, boilers, etc.) graphic displays. Data associated with an active display must be updated at least once every 5 seconds.

2.3.1.5.1 Navigation Scheme

System graphic displays of building systems and points must be hierarchical displays using a building-to-equipment point-and-click navigation scheme which allows navigation from a garrison-wide display, through a building-wide display to the individual units. Each display must show the building name and number. Each display must show system wide data such as outside air temperature and humidity in the case of an HVAC system application.

a. For each Building or Building Sub-Area display, show the building foot print and basic floor plan, and clearly show and distinguish between the individual zones and the equipment serving each zone and space. Show all space sensor and status readings, as applicable, for the individual zones such as space temperature, humidity, occupancy status, etc. Show the locations of individual pieces of monitored and controlled equipment.

b. For each equipment display show a one-line diagram control schematic or 3-dimensional representation of the individual pieces of equipment using the symbols and M&C point data types as specified. Use different colors and textures to indicate various components and real time data. Use consistent color and texture meanings across all displays.

c. Provide displays which clearly distinguish between the following point data types and information:

(1) Real-time data.

(2) Other user-entered data.

(3) Devices in alarm (unacknowledged).

(4) Out-of-range, bad, or missing data.

(5) Points which are overridden.

2.3.1.5.2 Navigation Commands

Provide system displays which support English language operator commands via point-and-click mouse or keyboard entry for defining and selecting points, parameters, graphics, report generation, and all other functions associated with operation. The operator commands must be usable from any operator workstation with individual operator passwords as specified.

2.3.1.6 Alarms

a. The creation, modification, and handling (routing) of alarms must be fully accessible and fully adjustable from the graphical user interface.

b. Alarm Data. Alarm data to be displayed and stored must include:

(1) Identification of alarm including building, system (or sub-system), and device name.

(2) Date and time to the nearest second of occurrence.

(3) Alarm type:

(a) Unreliable: Indicates that the source device has failed due to the sensing device or alarm parameter being out-of-range or bad data.

(b) High Alarm.

(c) Low Alarm.

(4) Current value or status of the alarm point, including engineering units.

(5) Alarm limits, including engineering units.

(6) Alarm priority.

(7) Alarm Message: A unique message with a field of at least 60

characters. Assignment of messages to an alarm must be an operator editable function.

(8) Acknowledgement status of the alarm including the time, date and user of acknowledgement.

2.3.1.7 Trending

a. The M&C Software must include a graphical display for trend configuration, creation and deletion accessible through the graphical user interface. Each trend must be user-configurable for:

(1) Point to trend.

(2) Sampling interval: Adjustable between 1 second and 1 hour.

(3) Start and Stop Time of Trend: Start and stop times determined by one or more of the following methods:

(a) Start time and stop time.

(b) Start time and duration.

(c) Start time and number of samples.

2.3.1.8 Report Generation

Integrate to make M&C Software capable of generating, saving and printing reports. Dynamic operation of the system must not be interrupted to generate a report. The report must contain the time and date when the samples were taken, and the time and date when the report was generated.

2.3.1.9 Custom Report Generation

2.3.1.9.1 M&C Software Override Report

Points overridden by the M&C Software, including time overridden, and identification of operator overriding the point.

2.3.1.9.2 Run Time Reports

A report totalizing the accumulated run time of individual pieces of equipment. The operator must be able to define equipment groupings and to generate reports based on these groupings.

2.3.1.9.3 Chiller usage Report

A report of the operation of each chiller as shown on a daily and monthly basis, for each of at least 10 discrete loading levels. The report must include:

a. Average power for the month at each level in kW.

b. Total monthly energy use in kWh at each level.

c. Total monthly energy use in kWh for the chiller (all levels).

d. Total daily run hours at each level.

e. Total Monthly run hours at each level.

2.3.1.9.4 Device Offline Report

A report listing all offline devices in all ASHRAE 135 building control systems integrated to the M&C Software.

PART 3 EXECUTION

3.1 DRAWINGS AND CALCULATIONS

3.1.1 EMCS IP Network Bandwidth Usage Estimate

Provide a EMCS IP Network Bandwidth Usage Estimate for a small, medium or large systems. In this estimate account for field control systems using all M&C required protocols and the integration of field control system via gateways. Define all assumptions used to create the estimate, including but not limited to: Trending, fast trends for commissioning, schedules, alarms, display of system graphics and load shedding.

3.1.2 EMCS Contractor Design Drawings

Revise and update the Contract Drawings to include details of the system design and all hardware components, including Contractor provided and Government furnished components. Details to be shown on the Design Drawing include:

a. The logical structure of the network, including but not limited to the location of all Control Hardware (including but not limited to each BACnet Supervisory Controller, Control Protocol Gateway, Control Protocol Router, and Monitoring and Control (M&C) Controller).

b. Manufacturer and model number for each piece of Control Hardware.

c. Physical location for each piece of Control Hardware.

d. Version and service pack number for all software and for all Control Hardware firmware.

3.1.3 As-Built Drawings

Prepare draft as-built drawings consisting of Points Schedule drawings for the entire EMCS, including Points Schedules for each Gateway, and an updated Design Drawing including details of the actual installed system as it is at the conclusion of Start-Up and Start-Up Testing. Provide As-Built Drawings which include details of all hardware components, including Contractor provided and Government furnished components. In addition to the details shown in the design drawings, the as-built drawing must include:

a. IP address(es) and Ethernet MAC address(es) as applicable for each piece of Control Hardware (including but not limited to each BACnet Supervisory Controller, Control Protocol Gateway, Control Protocol Router, and Monitoring and Control (M&C) Controller).

b. IP address and Ethernet MAC address for each computer server, workstation, and networked printer.

c. List of ports, protocols and network services for each device

connected to an IP network.

d. Network Addresses: ASHRAE 135 address and Object_ID of the Device Object for all Control Hardware using ASHRAE 135.

Prepare Draft As-Built Drawings upon the completion of Start-Up and Start-Up Testing and Final As-Built Drawings upon completion of PVT Phase II.

## 3.2 INSTALLATION OF EQUIPMENT

### 3.2.1 Wire and Cable Installation

Install system components and appurtenances in accordance with NFPA 70, manufacturer's instructions and as indicated. Provide necessary interconnections, services, and adjustments required for a complete and operable signal distribution system. Label components in accordance with TIA-606. Firestop Penetrations in fire-rated construction in accordance with Section 07 84 00 FIRESTOPPING. Install conduits, outlets and raceways in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install wiring in accordance with TIA-568-C.1 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Mark wiring terminal blocks and outlets in accordance with TIA-606. Do not install non-fiber-optic cables in the same cable tray, utility pole compartment, or floor trench compartment with power cables. Properly secure and install neat in appearance cables not installed in conduit or raceways.

### 3.2.2 Grounding

Install signal distribution system ground in accordance with TIA-607 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Connect equipment racks to the electrical safety ground.

### 3.2.3 Power-Line Surge Protection

Protect equipment connected to ac circuits must be protected against or withstand power-line surges. Provide equipment protection which meets the requirements of IEEE C62.41. Do not use fuses for surge protection.

### 3.2.4 IP Addresses

For all Control Hardware requiring an IP address on the EMCS IP Network, coordinate with the representative identified by the Contracting Officer to obtain IP addresses.

### 3.2.5 Computer Hardware and Software

#### 3.2.5.1 Software Installation

Install software as follows:

a. BACnet Network Browser: Install the BACnet Network Browser software as indicated. Install the BACnet Network Browser on workstation hardware.

b. Monitoring and Control Software: Install the monitoring and control (M&C)software as shown. Except for M&C Software performing Point Calculations, install M&C Software on server or controller hardware. Install M&C Software performing Point Calculations or Electrical Peak

Demand Limiting on either server hardware or Monitoring and Control (M&C) Controller Hardware. Install M&C Software in a manner consistent with its B-AWS listing such that it provides all functionality of a B-AWS.

Install M&C Software to support the number of points required in PART 2 (PRODUCTS), regardless of the number of points integrated under this project specification. Note that meeting this requirement may entail the installation of unused hardware or spare point licenses to accommodate the full number of required points in order to allow for integration of future field control systems.

Where software requires connection to an IP device outside of the EMCS, coordinate with the Contracting Officer to obtain access to a Government-furnished server to provide the needed functionality. Do not connect to any device outside of the EMCS without explicit permission from the Contracting Officer.

## 3.3 INTEGRATION OF FIELD CONTROL SYSTEMS

Fully integrate the field control systems in accordance with the following three step sequence and as specified and shown.

STEP 1: Install and configure Control Hardware as necessary to connect the field control system to the FPOC, which is part of the EMCS IP network, and to provide control protocol translation and supervisory functionality.

STEP 2: Add Field Control System to M&C Software: Perform system discovery, system database merges, or any other actions necessary to allow M&C Software access to the field control system.

STEP 3: Configure M&C Software to provide monitoring and control of the field control system, including but not limited to the creation of system displays and the configuration of scheduling, alarming, and trending.

### 3.3.1 Integration Step 1: Install Control Hardware

Install Control Hardware as specified at the FPOC location as shown to connect the field control system to the EMCS IP network via the FPOC and, if necessary, to provide control protocol translation and supervisory functionality. Coordinate all connections and other activities related to an FPOC with the Contracting Officer. Depending on the field control system media and protocol this must be accomplished through one of the following:

a. Connect the existing field control network hardware at the FPOC location to the FPOC.

b. Install a Control Protocol Router connected to both the field control network and the FPOC.

In addition, for integration of field control systems via ASHRAE 135, also install a BACnet Supervisory Controller as needed to implement scheduling, alarming and trending in the field control system. The BACnet supervisory controller may be the same device as the control protocol gateway or router.

3.3.1.1 Installation of Control Protocol Router

If there is not an existing connection between the FPOC and the field control network, install a BACnet/IP Router to connect the field control network to the FPOC. Install additional field control system network media as needed to connect the Router to the field control system.

3.3.1.2 Installation of BACnet Supervisory Controller

If required for implementation of scheduling, alarming and trending, install a BACnet Supervisory Controller connected to the building control system IP network and configure it to provide scheduling, alarming and trending functions for the field control system. When the BACnet Supervisory Controller is the same device as a control protocol router or gateway, install it in accordance with the installation requirements for a router or gateway.

3.3.2 Integration Step 2: Add Field Control System to M&C Software

Perform system discovery, system database merges, or any other actions necessary to allow M&C Software access to points and data in the field control system.

3.3.2.1 Integration of Field Control Systems Via ASHRAE 135

Use the M&C Software to fully discover the field control system. Full discovery of a field control system includes but is not limited to discovery of all ASHRAE 135 devices, all standard ASHRAE 135 Objects and Properties of each device, and all standard ASHRAE 135 services supported by each device.

3.3.2.2 Integration of Field Control Systems Via Other (non-ASHRAE 135) Protocols

Perform all actions necessary to make all points as shown on the Points Schedule from the field control system available in the M&C Software.

3.3.3 Integration Step 3: Configure M&C Software

Configure M&C Software to provide monitoring and control of the field control system, including but not limited to the creation of system displays and the configuration of scheduling, alarming, and trending.

3.3.3.1 Configure M&C Software Communication

Create and configure points and establish network communication between M&C Software and Field Control Systems as specified to support M&C Software functionality:

a. Update points on currently active displays via polling as necessary to meet M&C Software display refresh requirements.

b. Send points used for overrides to the device receiving the override as shown on the Points Schedule. For BACnet systems write operator overrides with a priority of 8 and demand limiting overrides with a priority of 10.

c. For Notification Class Objects used for Alarms, configure the Recipient_List Property to point to the appropriate M&C Software

process. Use the ConfirmedEventNotification service for events from ASHRAE 135 field control systems used for alarms.

3.3.3.2 Configure M&C Software Functionality

Fully configure M&C Software functionality using the M&C Software capabilities specified in PART 2 of this Section.

a. Create System Displays including overrides, as shown on the Points Schedule and as specified. Label all points on displays with the point name as shown on the Points Schedule. Configure user permissions for access to and executions of action using graphic pages. Coordinate user permissions with the Controls HVAC shop supervisor.

b. Configure alarm handling as shown on the Points Schedule, as shown on the Alarm Routing Schedule, and as specified. Create and configure Objects in BACnet Supervisory Controllers and in the field control system to support alarming as shown on the Points Schedule and as specified. Alarm events with priority 112 are critical and events with priority 224 are non-critical. For alarm events with other priorities, treat events with priorities of 200 or above as non-critical, and all others as critical. For alarms requiring notification via text message or e-mail, configure the alarm notification to use the specified Government furnished server to send the alarm notification.

c. Configure scheduling as indicated and as shown on the points schedule. Create and configure Schedule Objects in BACnet Supervisory Controllers or in the field control system.

   Create and configure displays for configuration of Schedule Objects in the field control system. Label schedules and scheduled points with full English-language descriptors. Provide a separate configuration capability for each schedule. A single configuration display may be used to configured multiple schedules, provided that each schedule is separately configurable from the display.

d. Create and configure Trend Objects in BACnet Supervisory Controllers and in the field control system as shown on the Points Schedule and as specified. Trend points at 15 minute intervals.

   Create and configure displays for creation and configuration of trends and for display of all trended points.

e. Configure Demand Limiting as shown on the Demand Limit Schedule and Points Schedule and as specified.

f. Configure M&C Software standard reports.

3.4 START-UP AND START-UP TESTING

Test all equipment and perform all other tests necessary to ensure the system is installed and functioning as specified. Prepare a Start-Up and Start-Up Testing Report documenting all tests performed and their results and certifying that the system meets the requirements specified in the contract documents.

## 3.5 PERFORMANCE VERIFICATION TEST (PVT)

### 3.5.1 PVT Phase I Procedures

Provide PVT Procedures which include:

a. Network bandwidth usage and available bandwidth (throughput) measurements. Network bandwidth usage must reference the normal usage network Bandwidth Calculations.

b. Test System Reaction during PVT: The total system response time from initiation of a control action command from the workstation, to display of the resulting status change on the workstation must not exceed 20 seconds under system normal heavy load conditions assuming a zero response time for operation of the node's control device.

c. Verification of IP Connectivity.

d. Verification of configuration of M&C Software functionality.

### 3.5.2 PVT Phase I

Demonstrate compliance of the control system with the contract documents. Using test plans and procedures previously approved by the Government, demonstrate all physical and functional requirements of the project. Upon completion of PVT Phase I and as specified, prepare and submit the PVT Phase I Report documenting all tests performed during the PVT and their results. In the PVT report, include all tests in the PVT Procedures and any other testing performed during the PVT. Document failures and repairs with test results.

### 3.5.3 PVT Phase II

Include Basic Training as part of PVT Phase II. Failures or deficiencies of the EMCS during Basic Training are considered PVT failures. Upon completion of PVT Phase II, and as specified, prepare and submit the PVT Phase II Report documenting any failures which occurred and repairs performed during PVT Phase II.

## 3.6 MAINTENANCE AND SERVICE

Perform inspection, testing, cleaning, and part or component replacement as specified and as required to maintain the warranty. Work includes providing necessary preventive and unscheduled maintenance and repairs to keep the EMCS operating as specified, and accepted by the Government, and other services as specified. Perform work in compliance with manufacturer's recommendations and industry standards. Provide technical support via telephone during regular working hours.

### 3.6.1 Work Coordination

Schedule and arrange work to cause the least interference with the normal Government business and mission. In those cases where some interference may be essentially unavoidable, coordinate with the Government to minimize the impact of the interference, inconvenience, equipment downtime, interrupted service and personnel discomfort.

3.6.2 Work Control

Upon completion of work on a system or piece of equipment, that system or piece of equipment must be free of missing components or defects which would prevent it from functioning as originally intended and designed. Replacements must conform to the same specifications as the original equipment. During and at completion of work, do not allow debris to spread unnecessarily into adjacent areas nor accumulate in the work area itself.

3.6.3 Working Hours

Working hours are from 6:30 A.M. to 4:00 P.M. local time Mondays through Fridays except Federal holidays.

3.6.4 Replacement, Modernization, Renovation

The Government may replace, renovate, or install new equipment as part of the EMCS at Government expense and by means not associated with this contract without voiding the system warranty. Replaced, improved, updated, modernized, or renovated systems and equipment interfaced to the system may be added to the Contractor's maintenance and service effort as a modification.

3.6.5 Access To EMCS Equipment

Access to EMCS equipment must be in accordance with the following:

a. Coordinate access to facilities and arrange that they be opened and closed during and after the accomplishment of the work effort. For access to a controlled facility contact the Government for assistance.

b. The Government may provide keys for access to EMCS equipment where the Government determines such key issuance is appropriate. Establish and implement methods of ensuring that keys issued by the Government are not lost or misplaced, are not used by unauthorized persons, and are not duplicated.

c. The Government may provide passwords or issue Common Access Cards (CAC) for access to EMCS computer equipment where the Government determines such issuance is appropriate. Establish and implement methods of ensuring that passwords and Common Access Cards issued by the Government are not used by unauthorized persons.

3.6.6 Records, Logs, and Progress Reports

Keep records and logs of each task, and organize cumulative chronological records for each major component, and for the complete system. Maintain a continuous log for the EMCS. Keep complete logs and be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the EMCS.

3.6.7 Preventive Maintenance Requirements

Prepare a Preventive Maintenance Work Plan as specified.

3.6.7.1 Preventive Maintenance Work Plan

Prepare a Preventive Maintenance Work Plan detailing all required

preventive maintenance. Obtain Government approval of the Work Plan as specified in paragraph PROJECT SEQUENCING. Strictly adhere to the approved work plan to facilitate Government verification of work. If it is necessary to reschedule maintenance, make a written request to the Government detailing the reasons for the proposed change at least five days prior to the originally scheduled date. Scheduled dates will be changed only with the prior written approval of the Government.

3.6.7.2 Semiannual Maintenance

Perform the following Semiannual Maintenance as specified:

a. Perform data backups on all Server Hardware.

b. Run system diagnostics and correct diagnosed problems.

c. Perform fan checks and filter changes for EMCS hardware.

d. Perform all necessary adjustments on printers.

e. Resolve all outstanding problems.

f. Install new ribbons, ink cartridges and toner cartridges into printers, and ensure that there is at least one spare ribbon or cartridge located at each printer.

3.6.7.3 Maintenance Procedures

3.6.7.3.1 Maintenance Coordination

Coordinate any scheduled maintenance event that may result in component downtime with the Government as follows, where time periods are measured as actual elapsed time from beginning of equipment off-line period, including working and non-working hours:

a. For non-redundant computer server hardware, provide 14 days notice, components must be off-line for no more than 8 hours.

b. For redundant computer server hardware, provide 7 days notice, components must be off-line for no more than 36 hours.

c. For active (powered) control hardware, provide 14 days notice, components must be off-line for no more than 6 hours.

d. For cabling and other passive network hardware, provide 21 days notice, components must be off-line for no more than 12 hours.

3.6.7.3.2 Software/Firmware

Software/firmware maintenance includes application programs, and files required for the proper operation of the EMCS regardless of storage medium. User (project site) developed software is not covered by this contract, except that the EMCS software/firmware must be maintained to allow user creation, modification, deletion, and proper execution of such user-developed software as specified. Perform diagnostics and corrective reprogramming as required to maintain total EMCS operations as specified. Back up software before performing any computer hardware and software maintenance. Do not modify any parameters without approval from the Government. Properly document any approved changes and additions, and

update the appropriate manuals.

3.6.8 Service Call Reception

a. A Government representative will advise the Contractor by phone or in person of all maintenance and service requests, as well as the classification of each based on the definitions specified. A description of the problem or requested work, date and time notified, location, classification, and other appropriate information will be placed on a Service Call Work Authorization Form by the Government.

b. Submit procedures for receiving and responding to service calls 24 hours per day, seven days a week, including weekends and holidays and during regular working hours. Provide a single telephone number for receipt of service calls during regular working hours; service calls are to be considered received at the time and date the telephone call is placed by the authorized Government representative.

c. Separately record each service call request, as received on the Service Call Work Authorization form and complete the Service Call Work Authorization form for each service call. Include the following information in the completed form: The serial number identifying the component involved, 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.

d. Respond to each service call request within two working hours. Provide the status of any item of work within four hours of the inquiry during regular working hours, and within 16 hours after regular working hours or as needed to meet the Equipment Repair requirements as specified.

3.6.9 Service Call Work Warranty

Provide a 1 year unconditional warranty on service call work which includes labor and material necessary to restore the equipment involved in the initial service call to a fully operable condition. In the event that service call work causes damage to additional equipment, restore the system to full operation without cost to the Government. Provide response times for service call warranty work equivalent to the response times required by the initial service call.

3.6.10 System Modifications

Make recommendations for system modification in writing to the Government. Do not make system modifications without prior approval of the Government. Incorporate any modifications made to the system into the Operations and Maintenance Instructions, and any other documentation affected. Make available to the Government software updates for all software furnished under this specification during the life of this contract. Schedule at least one update near the end of the contract period, at which time make available the latest released version of all software provided under this specification, and install and validate it upon approval by the Government.

## 3.7 TRAINING

Conduct training courses for designated personnel in the maintenance, service, and operation of the system as specified, including specified hardware and software. The training must be oriented to the specific system provided under this contract. Provide audiovisual equipment and other training material and supplies required for the training. When training is conducted at Government facilities, the Government reserves the right to record the training sessions for later use. A training day is defined as 8 hours of classroom instruction, excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility. For guidance in planning the required instruction, the Contractor should assume that attendees will be tradesmen such as electricians or boiler operators. Obtain approval of the training schedule from the Government at least 30 days prior to the first day of training.

### 3.7.1 Training Documentation

Prepare and submit one set of Training manuals for each of Basic Training Documentation, Advanced Training Documentation, and Refresher Training Documentation, where each set of documentation consists of:

#### 3.7.1.1 Course Attendance List

Course Attendance List developed in coordination with and signed by the Controls HVAC shop supervisor.

#### 3.7.1.2 Training Manuals

Include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson in the training manuals. Where portions of the course material are presented by audiovisuals, include copies of those audiovisuals as a part of the printed training manuals.

### 3.7.2 Basic Training

Conduct a Basic Training course at the project site on the installed system for a period of no less than 5 training days during Phase 2 of the PVT. A maximum of ten personnel will attend this course. Design training targeted towards training personnel in the day-to-day operation and basic maintenance of the system. Upon completion of this course, each student, using appropriate documentation, should be able to start the system, operate the system, recover the system after a failure, perform routine maintenance and describe the specific hardware architecture and operation of the system. Include the following topics at a minimum:

a. General system architecture.

b. Functional operation of the system, including workstations and system navigation.

c. System start-up procedures.

d. Failure recovery procedures.

e. Schedule configuration.

f. Trend configuration.

g. Perform point overrides and override release.

h. Reports generation.

i. Alarm reporting and acknowledgements.

j. Diagnostics.

k. Historical files.

l. Maintenance procedures:

(1) Physical layout of each piece of hardware.

(2) Troubleshooting and diagnostic procedures.

(3) Preventive maintenance procedures and schedules.

3.7.3 Advanced Training

Conduct an Advanced Operator Training course at the project site for a period of not less then five days. A maximum of ten personnel will attend this course. Structure the course to consist of "hands-on" training under the constant monitoring of the instructor. Include training on the M&C Software, and the BACnet Network Browser. Upon completion of this course, the students should be fully proficient in the operation and management of all system operations and must be able to perform all tasks required to integrate a field control system into the EMCS. Report the skill level of each student at the end of this course. Include the following topics at a minimum:

a. A review of all topics in Basic Training.

b. Using the BACnet Network Browser for network discovery.

c. M&C Software configuration, including but not limited to: Creating and editing system displays, alarms, schedules, trends, demand limiting and calculations.

3.7.4 Refresher Training

Conduct a Refresher Training course at the project site for a period of two training days when approved by the Government and as specified in paragraph PROJECT SEQUENCING. A maximum of ten personnel will attend the course. Structure the course to address specific topics that the students need to discuss and to answer questions concerning the operation of the system. Upon completion of the course, the students should be fully proficient in system operation and have no unanswered questions regarding operation of the installed EMCS. Correct any system failures discovered during the Refresher Training at no cost to the Government.

APPENDIX A

| | | | |
|---|---|---|---|
| **QC CHECKLIST** | | | |
| This checklist is not all-inclusive of the requirements of this specification and should not be interpreted as such. | | | |
| This checklist is for (check one:) | | | |
| | Pre-Construction QC Checklist Submittal (Items 1-2) | | ( ) |
| | Post-Construction QC Checklist Submittal (Items 1-6) | | ( ) |
| | Close-out QC Checklist Submittal (Items 1-14) | | ( ) |
| | | | |
| Instructions: Initial each item in the space provided (\|____\|) verifying that the requirement has been met. | | | |
| **Verify the following items for Pre-Construction, Post-Construction and Closeout QC Checklist Submittals:** | | | |
| 1 | Contractor Design Drawing Riser Diagram includes location and types of all Control Hardware and Computer Hardware. | | \|____\| |
| 2 | M&C Software supports , and ASHRAE 135 . M&C Software is BTL Listed as a B-AWS. | | \|____\| |
| **Verify the following items for Post-Construction and Closeout QC Checklist Submittal:** | | | |
| 3 | Communication between the M&C Software and ASHRAE 135 field control systems uses only ASHRAE 135. | | \|____\| |

| | **QC CHECKLIST** | | |
|---|---|---|---|
| 4 | Connections to non-ASHRAE 135field control systems are via a Gateway from the field control system to ASHRAE 135 or via a EMCS supported protocol without the use of a hardware Gateway. | | \|____\| |
| 5 | Computer workstations and servers are installed as shown on the EMCS Riser Diagram. | | \|____\| |
| 6 | Training schedule and course attendee lists have been developed and coordinated with shops and submitted. | | \|____\| |
| **Verify the following items for Closeout QC Checklists Submittal:** | | | |
| 7 | All points in field control systems have been discovered and are available at the M&C Software. | | \|____\| |
| 8 | All software has been licensed to the Government. | | \|____\| |
| 9 | M&C software monitoring displays have been created for all building systems, including all override and display points indicated on Points Schedule drawings. | | \|____\| |
| 10 | Final As-built Drawings accurately represent the final installed system. | | \|____\| |
| 11 | Default trends have been set up (per Points Schedule drawings). | | \|____\| |
| 12 | Scheduling has been configured at the M&C Software (per Occupancy Schedule drawing). | | \|____\| |
| 13 | O&M Instructions have been completed and submitted. | | \|____\| |

| QC CHECKLIST | | | |
|---|---|---|---|
| 14 | Basic Operator and Advanced Training courses have been completed. | | \|____\| |
| | _____ | _____ | |
| | (QC Representative Signature) | (Date) | |

-- End of Section --

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SECTION 26 08 00

APPARATUS INSPECTION AND TESTING

**11/21**

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-- End of Section Table of Contents --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING
**11/21**

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.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

| | |
|---|---|
| NETA ATS | (2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems |

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

SD-07 Certificates

Qualifications of Organization, and Lead Engineering Technician

Acceptance Test and Inspections Procedure

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 (Level III) 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 12 19.10 THREE-PHASE, LIQUID-FILLED PAD-MOUNTED TRANSFORMERS

b. Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Medium voltage cables and grounding systems only.

c. 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.

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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 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/ |

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 | (2021) General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers |
| IEEE C57.12.28 | (2014) Standard for Pad-Mounted Equipment - Enclosure Integrity |
| IEEE C57.12.34 | (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 | (2021) 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 | (2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems |

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; TIA 22-1; ERTA 1 2022) 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 |

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 | (2022) 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-RO

SD-03 Product Data

Pad-mounted Transformers; G-RO

SD-06 Test Reports

Acceptance Checks and Tests; G-RO

SD-07 Certificates

Transformer Efficiencies; G-RO

SD-09 Manufacturer's Field Reports

Transformer Test Schedule; G-RO

Pad-mounted Transformer Design Tests; G-RO

Pad-mounted Transformer Routine and Other Tests; G-RO

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G-RO

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.

d. One-line diagram, including switch(es).

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. Provide all access panels and openings with a pad lockable means of excluding access from unauthorized individuals.

#### 2.2.1.1 High Voltage, Dead-Front

High-voltage compartment contains: the incoming line, insulated high-voltage load-break connectors, bushing well inserts, six high-voltage bushing wells 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.

Minimum high-voltage compartment dimensions: IEEE C57.12.34, Figures 16 and 17.

a. Insulated high-voltage load-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 200 amperes rms continuous. Short time rating: 10,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector must have a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

b. Bushing well inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.

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 200 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 |

| ARRANGEMENT NO. | DESCRIPTION OF SWITCH ARRANGEMENT | SWITCH POSITION | | | | | |
|---|---|---|---|---|---|---|---|
| | | LINE A SW. | | LINE B SW | | XFMR. SW | |
| | | OPEN | CLOSE | OPEN | CLOSE | OPEN | CLOSE |
| 2 | Transformer connected to Line A only | | X | X | | | X |
| 3 | Transformer connected to Line Bonly | 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 9 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap. Provide six 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 13.10 30 ELECTRIC METERS.

2.2.2 Transformer

a. Less-flammable bio-based liquid-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.

b. Transformer rated 750 kVA.

c. Transformer voltage ratings: 12470 V Delta 480 - 277 V GrdY.

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:

| kVA | DECIBELS (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.

(4) kVA rating conspicuously displayed on its enclosure.

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.

| kVA | EFFICIENCY (percent) |
|---|---|
| 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

Paint entire transformer assembly Dark Bronze, with paint coating system complying with IEEE C57.12.28 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 work "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.

## 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 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 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.

3.6.1.2 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.

3.6.1.3 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.

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SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM
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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.

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 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 | (2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems |

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

| | |
|---|---|
| NECA NEIS 1 | (2015) Standard for Good Workmanship in Electrical Construction |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| ANSI C80.1 | (2020) American National Standard for Electrical Rigid Steel Conduit (ERSC) |
| ANSI C80.3 | (2020) American National Standard for Electrical Metallic Tubing (EMT) |
| ANSI C80.5 | (2020) American National Standard for |

| | |
|---|---|
| | Electrical Rigid Aluminum Conduit |
| NEMA 250 | (2020) 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 2020) 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 | (2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31 |
| 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 | (2021) 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 2020) 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; TIA 22-1; ERTA 1 2022) National Electrical Code |
| NFPA 70E | (2021) Standard for Electrical Safety in the Workplace |
| NFPA 780 | (2023) Standard for the Installation of Lightning Protection Systems |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA-568.1 | (2020e) Commercial Building Telecommunications Infrastructure Standard |
| TIA-569 | (2019e) Telecommunications Pathways and Spaces |
| TIA-607 | (2019d) 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 6 | (2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel |
| UL 6A | (2008; Reprint Mar 2021) UL Standard for Safety Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel |
| UL 20 | (2018; Reprint Jan 2021) UL Standard for Safety 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 248-4 | (2010; Reprint Apr 2019) Low-Voltage Fuses - Part 4: Class CC Fuses |
| UL 248-8 | (2011; Reprint Aug 2020) Low-Voltage Fuses - Part 8: Class J Fuses |
| UL 248-10 | (2011; Reprint Aug 2020) Low-Voltage Fuses - Part 10: Class L Fuses |
| UL 248-12 | (2011; Reprint Aug 2020) Low Voltage Fuses - Part 12: Class R Fuses |
| UL 248-15 | (2018) Low-Voltage Fuses - Part 15: Class T Fuses |
| UL 360 | (2013; Reprint Aug 2021) UL Standard for Safety Liquid-Tight Flexible Metal Conduit |
| UL 467 | (2022) UL Standard for Safety Grounding and Bonding Equipment |
| UL 486A-486B | (2018; Reprint May 2021) UL Standard for Safety Wire Connectors |
| UL 486C | (2018; Reprint May 2021) 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 Sep 2021) UL Standard for Safety Attachment Plugs and Receptacles |
| UL 506 | (2017; Reprint Jan 2022) UL Standard for Safety Specialty Transformers |
| UL 508 | (2018; Reprint Jul 2021) 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 May 2022) UL Standard for |

| | |
|---|---|
| | Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings |
| UL 797 | (2007; Reprint Mar 2021) UL Standard for Safety Electrical Metallic Tubing -- Steel |
| 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; Reprint Jun 2020) UL Standard for Safety Machine-Tool Wires and Cables |
| UL 1242 | (2006; Reprint Apr 2022) UL Standard for Safety Electrical Intermediate Metal Conduit -- Steel |
| UL 1449 | (2021) UL Standard for Safety Surge Protective Devices |
| UL 2043 | (2013) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces |
| UL 4248-1 | (2022) 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

Transformers

Cable Trays

Marking Strips Drawings

SD-03 Product Data

Receptacles

Circuit Breakers

Switches

Transformers

Enclosed Circuit Breakers

Motor Controllers

Manual Motor Starters

CATV Outlets

Secondary Bonding Busbar

Surge Protective Devices

Cable Trays

SD-05 Design Data

Cable Tray Design

SD-06 Test Reports

600-volt Wiring Test

Grounding System Test

Transformer Tests

Ground-fault Receptacle Test

SD-07 Certificates

Fuses

SD-09 Manufacturer's Field Reports

Transformer Factory Tests

## 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, "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. NECA NEIS 1 shall be considered the minimum standard for workmanship.

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 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 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, limited to 6 feet.

2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360, limited to 6 feet.

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

Die Cast compression type.

2.2.8 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.3 CABLE TRAYS

NEMA VE 1. Provide the following:

Submit cable tray design, including dimensional layout, load and seismic calculations, and fill calculations. Dimensional layout includes cable spacings, cable tray splices, and supports. Fill calculations include an index of cables for each section and identification of the lb/ft, cross

sectional area, and insulation voltage class for each cable.

a. Cable trays: form a wireway system, with a nominal 4 inch depth.

b. Cable trays: constructed of steel that has been zinc-coated after fabrication.

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. Radius of bends: 36 inches.

2.3.1 Basket-Type Cable Trays

Provide 12 inch width and 4 inch depth with maximum wire mesh spacing of 2 by 4 inch.

2.3.2 Ladder-Type Cable Trays

Provide 12 inch width with maximum rung spacing of 6 inches.

2.4 OPEN TELECOMMUNICATIONS CABLE SUPPORT

2.4.1 Open Top Cable Supports

Provide open top cable supports in accordance with UL 2043. Provide zinc-coated steel open top cable supports as indicated.

2.4.2 Closed Ring Cable Supports

Provide closed ring cable supports in accordance with UL 2043. Provide galvanized zinc-coated steel closed ring cable supports as indicated.

2.5 OUTLET BOXES AND COVERS

UL 514A, cadmium- or zinc-coated, if ferrous metal. UL 514C, if nonmetallic.

2.5.1 Floor Outlet Boxes

Provide the following:

a. Boxes: adjustable and concrete tight.

b. Each outlet: consisting of nonmetallic or cast-metal body with threaded openings, or sheet-steel body with knockouts for conduits, adjustable ring, and cover plate with 1 1/4 inch threaded plug.

c. Telecommunications outlets: consisting of flush, aluminum or stainless steel housing with a receptacle as specified and 1 inch top opening.

d. Receptacle outlets: consisting of flush aluminum or stainless steel

housing with duplex-type receptacle as specified herein.

e. Provide gaskets where necessary to ensure watertight installation.

2.5.2 Outlet Boxes for Telecommunications System

Provide the following:

a. Standard type 4 inches square by 2 1/8 inches deep 4 11/16 inches square by 2 1/8 inches deep.

b. Outlet boxes for wall-mounted telecommunications outlets: 4 by 2 1/8 by 2 1/8 inches deep.

c. Depth of boxes: large enough to allow manufacturers' recommended conductor bend radii.

d. Outlet boxes for fiber optic telecommunication outlets: include a minimum 3/8 inch deep single or two gang plaster ring as shown and installed using a minimum one inch conduit system.

e. Outlet boxes for handicapped telecommunications station: 4 by 2 1/8 by 2 1/8 inches deep.

2.6 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.

2.7 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.

2.7.1 Conductors

Provide the following:

a. Conductor sizes and capacities shown are based on copper, unless indicated otherwise.

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.

2.7.1.1 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.

2.7.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.7.2.1 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.

2.7.2.2 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. 120/240 volt, single phase: Black and red

2.7.3 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 equipment or devices require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.7.4 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.

2.7.4.1 Telecommunications Bonding Backbone (TBB)

Provide a copper conductor TBB in accordance with TIA-607 with No. 6 AWG minimum size, and sized at 2 kcmil per linear foot of conductor length up to a maximum size of 750 kcmil. Provide insulated TBB with insulation as specified in the paragraph INSULATION and meeting the fire ratings of its pathway.

2.7.4.2 Bonding Conductor for Telecommunications

Provide a copper conductor Bonding Conductor for Telecommunications between the telecommunications main grounding busbar (PBB) and the electrical service ground in accordance with TIA-607. Size the bonding conductor for telecommunications the same as the TBB.

2.7.5 Service Entrance Cables

Service Entrance (SE) and Underground Service Entrance (USE) Cables, UL 854.

2.8 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.

2.9 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."

## 2.10 SWITCHES

### 2.10.1 Toggle Switches

NEMA WD 1, UL 20, single pole, double pole, three-way, and four-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.

### 2.10.2 Switch with Red Pilot Handle

NEMA WD 1. Provide the following:

a. Pilot lights that are integrally constructed as a part of the switch's handle.

b. Pilot light color: red and illuminate whenever the switch is closed or "on".

c. Pilot lighted switch: rated 20 amps and 120 volts or 277 volts as indicated.

d. The circuit's neutral conductor to each switch with a pilot light.

### 2.10.3 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.

## 2.11 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.

### 2.11.1 Fuseholders

Provide in accordance with UL 4248-1.

### 2.11.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 248-12, ClassRK-1, RK-5, or time-delay type as necessary. Provide only Class R associated fuseholders in accordance with UL 4248-12.

2.11.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 248-8, UL 248-10, UL 248-4, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.11.4 Cartridge Fuses, Current Limiting Type (Class T)

UL 248-15, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.12 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.

i. Controlled receptacles: as required per ASHRAE 90.1. Provide marking for controlled receptacle per NFPA 70.

2.12.1 Split Duplex Receptacles

Provide separate terminals for each ungrounded pole. One receptacle must be controlled separately.

2.12.2 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations" with integral GFCI protection. Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, die-cast metal/aluminum cover plate.

2.12.3 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.

2.12.4 Special Purpose Receptacles

Receptacles serving WLT Devices and portable 400Hz frequency converters

are special purpose.

2.13 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 design drawings. If it is not possible to match "specific breaker placement" during construction, obtain Government approval prior to device installation.

f. Use of "Subfeed Breakers" is not acceptable.

g. Main breaker: "separately" mounted "above" 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. Provide new directories for existing panels modified by this project as indicated.

l. Type directories and mount in holder behind transparent protective covering.

m. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.13.1 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. Front edges of cabinets: form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front.

e. 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.

f. 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.

g. Flush doors: mounted on hinges that expose only the hinge roll to view when the door is closed.

h. Each door: fitted with a combined catch and lock latch.

i. Keys: two provided with each lock, with all locks keyed alike.

j. Finished-head cap screws: provided for mounting the panelboard fronts1 on the cabinets.

2.13.2 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.

2.13.3 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. Where indicated on the drawings, provide circuit breakers with shunt trip devices. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.13.3.1 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.

2.13.3.2 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.

2.14 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 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. Taps for transformers 15 kVA and larger: Two 2.5 percent taps Full Capacity Above Nominal (FCAN) and two 2.5 percent taps Full Capacity Below Nominal (FCBN).

d. 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.

e. Transformer of 115 degrees C temperature rise: capable of carrying continuously 115 percent of nameplate kVA without exceeding insulation rating.

### 2.15.1 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 MOTORS

Provide motors in accordance with the following:

a. NEMA MG 1 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.

i. Use Inverter-Rated motors designed to operate with adjustable speed drive (ASD) where indicated on the mechanical schedules.

2.16.1 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.

2.16.2 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.

2.16.3 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.

2.16.4 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 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.

2.17 MOTOR CONTROLLERS

Provide motor controllers in accordance with the following:

a. UL 508, NEMA ICS 1, and NEMA ICS 2.

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: as indicated by source connection.

2.17.1 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.

2.17.2 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.

2.17.2.1 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.

2.17.3 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.

2.17.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.17.5 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.

2.17.6 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations: heavy duty, oil-tight design.

2.17.7 Pilot and Indicating Lights

Provide LED cluster lamps.

2.18 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

Single, double, or three pole designed for surface mounting with overload protection as required.

2.18.1 Pilot Lights

Provide yoke-mounted, seven element LED cluster light module. Color: green.

2.19 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.

2.20 TELECOMMUNICATIONS SYSTEM

Provide system of telecommunications wire-supporting structure, including: outlet boxes, conduits with pull wires wireways, cable trays, and other accessories for telecommunications outlets and pathway in accordance with TIA-569 and as specified herein. Additional telecommunications requirements are specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

## 2.21 COMMUNITY ANTENNA TELEVISION (CATV) SYSTEM

### 2.21.1 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.

### 2.21.2 CATV Faceplates

Provide modular faceplates for mounting of CATV Outlets. Faceplate: include designation labels and label covers for circuit identification. Faceplate color: match outlet and switch coverplates.

### 2.21.3 Backboards

Provide void-free, fire rated interior grade plywood, 3/4 inch thick, 4 by 8 feet 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.

## 2.22 GROUNDING AND BONDING EQUIPMENT

### 2.22.1 Ground Rods

UL 467. Ground rods: cone pointed copper-clad steel, with minimum diameter of 3/4 inch and minimum length 10 feet. Sectional type rods may be used for rods 20 feet or longer.

### 2.22.2 Ground Bus

Copper ground bus: provided in the electrical equipment rooms as indicated.

### 2.22.3 Secondary Bonding Busbar

Provide corrosion-resistant grounding busbar suitable for indoor 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 busbar (PBB) in the telecommunications entrance facility and a Secondary bonding busbar (SBB) in all other telecommunications rooms and equipment rooms. The Primary bonding busbar (PBB) and the Secondary bonding busbar (SBB): sized in accordance with the immediate application requirements and with consideration of future growth. Provide Secondary bonding 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 SBBs with length as indicated

c. Listed by a nationally recognized testing laboratory.

## 2.23 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.

2.24 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. Provide red laminated plastic label with white center core where indicated.

f. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.

g. Minimum size of nameplates: one by 2.5 inches.

h. Lettering size and style: a minimum of 0.25 inch high normal block style.

2.25 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.

2.26 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00 FIRESTOPPING.

2.27 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices (SPD) which comply with UL 1449 at the service entrance , panelboards . 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 must 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 per NFPA 780 for the lightning protection system.

Maximum L-N, and N-G Voltage Protection Rating:

600V for 208Y/120V, three phase system
1,200V for 480Y/277V, three phase system

Maximum L-G Protection Rating:

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
1,800V for 480Y/277V, three phase system

## 2.28 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 Dark Gray.

g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.29 SOURCE QUALITY CONTROL

2.29.1 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.

2.30 COORDINATED POWER SYSTEM PROTECTION

Prepare analyses as specified in Section 26 28 01.00 10 COORDINATED POWER SYSTEM PROTECTION.

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.

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 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.

3.1.4.7 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.

3.1.4.8 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Plastic cable ties are not acceptable. 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. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. 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.

3.1.4.9 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.

3.1.4.10 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.

3.1.4.11 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. Plastic cable ties are not acceptable as a support method.

3.1.4.12 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-568.1. 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.

3.1.5 Busway Installation

Comply at minimum with NFPA 70. Install busways parallel with or at right angles to ceilings, walls, and structural members. Support busways at 5 foot maximum intervals, and brace to prevent lateral movement. Provide fixed type hinges on risers; spring-type are unacceptable. Provide

flanges where busway makes penetrations through walls and floors, and seal to maintain smoke and fire ratings. Provide waterproof curb where busway riser passes through floor. Seal gaps with fire-rated foam and caulk. Provide expansion joints, but only where bus duct crosses building expansion joints. 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 Cable Tray Installation

Install and ground in accordance with NFPA 70. In addition, install and ground telecommunications cable tray in accordance with TIA-569, and TIA-607. Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Cable tray and tray supports must not partially nor completely obstruct access to the room. Support in accordance with manufacturer recommendations but at not more than 6 foot intervals as indicated. Coat contact surfaces of aluminum connections with an antioxidant compound prior to assembly. Adjacent cable tray sections: bonded together by connector plates of an identical type as the cable tray sections. For grounding of cable tray system provide No. 2 AWG bare copper wire throughout cable tray system, and bond to each section, except use No. 1/0 aluminum wire if cable tray is aluminum. Terminate cable trays 10 inches from both sides of smoke and fire partitions. Install conductors run through smoke and fire partitions in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Firestop penetrations in accordance with Section 07 84 00, FIRESTOPPING. 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.

Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Cable tray and tray supports must not partially nor completely obstruct access to the room. Support at 6 foot intervals. In addition, install and ground telecommunications cable tray in accordance with TIA-569, and TIA-607 Coat contact surfaces of aluminum connections with an antioxidant compound prior to assembly. 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 though 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.

### 3.1.7 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.

### 3.1.8 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, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, 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. Threaded studs driven in by powder charge and provided with lock washers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. 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.

#### 3.1.8.1 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 4 11/16 inches square by 2 1/8 inches deep, except for wall mounted telephones and outlet boxes for handicap telephone stations. Mount outlet boxes flush in finished walls.

#### 3.1.8.2 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.

#### 3.1.8.3 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.

3.1.9 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of center of grip of the operating handle of the switch or circuit breaker at its highest position is maximum 79 inches above floor or working platform or as allowed in Section 404.8 per NFPA 70. Mount lighting switches 48 inches above finished floor. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Wall-mounted telecommunications outlets: mounted at height 60 inches above finished floor.

3.1.10 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.

3.1.10.1 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.

### 3.1.11 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.

### 3.1.12 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.

### 3.1.13 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

### 3.1.14 Grounding and Bonding

Provide in accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems. 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.

#### 3.1.14.1 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, use additional rods as necessary additional rods, spaced on center. Spacing for additional rods must be a minimum of 10 feet, or if sectional type rods are used. 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.

#### 3.1.14.2 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.

3.1.14.3 Ground Bus

Provide a copper ground bus in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of 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.

3.1.14.4 Resistance

Maximum resistance-to-ground of grounding system: do not exceed25 ohms under dry conditions. Where resistance obtained exceeds25 ohms, contact Contracting Officer for further instructions.

3.1.14.5 Telecommunications System

Provide telecommunications grounding in accordance with the following:

a. Telecommunications Grounding Busbars: Provide a Primary bonding busbar (PBB) in the telecommunications entrance facility. Install the PBB as close to the electrical service entrance grounding connection as practicable. Provide a Secondary bonding busbar (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 SBB 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 SBB. Install Secondary bonding 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 SBBs 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 SBB 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 SBB 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.

3.1.15 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.

3.1.16 Repair of Existing Work

Perform repair of existing work, demolition, and modification of existing electrical distribution systems as follows:

3.1.16.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling,

chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.16.2 Existing Concealed Wiring to be Removed

Disconnect existing concealed wiring to be removed from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.16.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment includes equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, back to equipment's power source as indicated.

3.1.16.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Maintain existing circuits of equipment energized. Restore circuits wiring and power which are to remain but were disturbed during demolition back to original condition.

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. Do not locate surge protective devices inside a panelboard or switchboard enclosure.

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. Where applicable, test electrical equipment in accordance with NETA ATS.

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 must 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.

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SWITCHBOARDS
**08/21**

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 |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A780/A780M | (2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings |
| 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 |

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

| | |
|---|---|
| NETA ATS | (2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems |

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; TIA 22-1; ERTA 1 2022) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489 (2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 891 (2019) UL Standard for Safety 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-RO

SD-03 Product Data

Switchboard; G-RO

SD-06 Test Reports

Switchboard Design Tests; G-RO

Switchboard Production Tests; G-RO

Acceptance Checks and Tests; G-RO

SD-10 Operation and Maintenance Data

Switchboard Operation and Maintenance, Data Package 5; G-RO

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals

Equipment Test Schedule

Required Settings

Service Entrance Available Fault Current Label

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, 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.

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.

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 one 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: 1000 amperes.

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 front and rear aligned.

b. All circuit breakers: front accessible.

c. Front and rear aligned switchboards.

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 1.

b. Enclosure: bolted together with removable bolt-on side and rear covers.

c. Base: includes any part of enclosure that is within 3 inches of concrete pad.

d. Paint color: ASTM D1535 light gray No. 61 or No. 49 over rust inhibitor.

2.2.2.2 Bus Bars

Provide the following:

a. Bus bars: aluminum with tin-plated contact surfaces.

(1) Phase bus bars: uninsulated.

(2) Neutral bus: rated 100 percent of the main bus continuous current rating.

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.

2.2.2.3 Main Section

Provide the main section consisting of an individually mounted molded-case circuit breaker.

2.2.2.4 Distribution Sections

Provide the distribution sections consisting of molded-case circuit breakers as indicated.

2.2.3 Protective Device

Provide main and branch protective devices as indicated.

2.2.3.1 Molded-Case Circuit Breaker

Provide the following:

a. UL 489. UL listed and labeled, 100 percent rated main breaker, electrically 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 Electronic Trip Units

Equip breakers as indicated 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: as indicated.

d. Electronic trip units: provide additional features as indicated:

(1) Breakers: include long delay pick-up and time settings, and LED indication of cause of circuit breaker trip.

(2) Main breakers: include short delay pick-up and time settings, instantaneous settings and ground fault settings as indicated.

(3) Distribution breakers: include short delay pick-up and time settings, instantaneous settings, and ground fault settings as indicated.

(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.

2.2.5 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.

2.2.6 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 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 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 COORDINATED POWER SYSTEM PROTECTION

Provide a power system study as specified in Section 26 28 01.00 10 COORDINATED POWER SYSTEM PROTECTION.

2.7 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.

2.8 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.

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 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.

3.2.1 Switchboard

ANSI/NEMA PB 2.1.

3.2.2 Meters and Instrument Transformers

ANSI C12.1.

3.2.3 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.

3.2.4 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.

3.2.5 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.

3.3 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES

3.3.1 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.

3.4 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.

3.4.1 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.

3.4.1.1 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) 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.

(8) Confirm correct operation and sequencing of electrical and mechanical interlock systems.

(9) Confirm correct application of manufacturer's recommended lubricants.

(10) Inspect insulators for evidence of physical damage or contaminated surfaces.

(11) Verify correct barrier installation and operation.

(12) Exercise all active components.

(13) Inspect all mechanical indicating devices for correct operation.

(14) Verify that filters are in place and vents are clear.

(15) Test operation, alignment, and penetration of instrument transformer withdrawal disconnects.

(16) 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.

3.4.1.2 Circuit Breakers

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

3.4.1.3 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.

3.4.1.4 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.

3.4.1.5 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.

3.4.2 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 five working days advance notice of the dates and times for checks, settings, and tests.

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ELECTRIC METERS
**10/07, 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.

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 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) Standard Requirements for Instrument Transformers |

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

| | |
|---|---|
| IEC 61000-4-5 | (2017) Electromagnetic Compatibility (EMC) - Part 4-5: Testing and Measurement Techniques - Surge Immunity Test |
| IEC 62053-22 | (2020) Electricity Metering Equipment (A.C.) - Particular Requirements - Part 22: Static Meters for Active Energy (Classes 0,2 S and 0,5 S) |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| 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 |
| ANSI C62.61 | (1993) American National Standard for Gas Tube Surge Arresters on Wire Line Telephone Circuits |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification 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:

a. Provide the following in the maintenance manual:

1. Condensed description of how the equipment operates.
2. Block diagram indicating major assemblies.
3. Troubleshooting information
4. Preventive maintenance.
5. Spare parts information.

b. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data."

SD-03 Product Data

Power Meters; G-RO

Current Transformers; G-RO

Potential Transformer; G-RO

Communications Module; G-RO

Protocol Modules; G-RO

Data Recorder; G-RO

Modem

Include manufacturer's information for each component, device, and accessory provided with the meter, protocol module or communications module.

SD-06 Test Reports

Acceptance Checks and Tests; G-RO

SD-10 Operation and Maintenance Data

Power Meters; G-RO

Communications Module; G-RO

Protocol Modules; G-RO

Data Recorder; G-RO

Modem; G-RO

SD-11 Closeout Submittals

System Function Verification; G-RO

1.4 QUALITY ASSURANCE

1.4.1 Installation Drawings

Drawings indicate but are not limited to the following:

a. Elementary diagrams and wiring diagrams with terminals identified of advanced meter, current transformers, potential transformers, protocol modules, communications modules, Ethernet connections, telephone lines. For each meter installation, provide a diagram identified by the building number.

b. One-line diagram, including meters, switch(es), current transformers, potential transformers, protocol modules, communications modules, Ethernet connections, telephone outlets, and fuses. For each meter installation, provide a diagram identified by the building number.

1.4.2 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. Provide products that have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Provide product that has 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 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.

1.4.3 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.

1.4.4 Material and Equipment Manufacturing Data

Do not use products manufactured more than 2 years prior to date of delivery to site, unless specified otherwise.

1.5 WARRANTY

Provide equipment items 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.

## 1.6 SYSTEM DESCRIPTION

### 1.6.1 System Requirements

The metering and reading system, consisting of commercial, off-the-shelf meters, protocol modules, communications modules, and communication channels, will be used to record the electricity consumption and other values as described in the sections that follow and as shown on the drawings.

### 1.6.2 Selection Criteria

Metering components are part of a system that includes the physical meter, data recorder function and communications (modem) method. Include sufficient metering components to measure the electrical parameters identified and to store and communicate the values as required in the following sections for every building site identified. Verify that the metering system installed on any building site is compatible with the facility-wide communication and meter-reading protocol system. Contractor must connect the metering system to the facility-wide energy and utility monitoring and control system.

# PART 2 PRODUCTS

## 2.1 POWER METERS

### 2.1.1 Physical and Common Requirements

a. Install metering system components according to the Metering System Schedule shown in this specification.

b. Power meter must be panel-mounted design. Furnish meters that are semi-flush, back-connected, dustproof, draw-out switchboard type. Provide cases with 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. Incorporate necessary test devices within each meter and provide means for testing either from an external source of electric power or from associated instrument transformers or bus voltage.

c. If existing meter base is usable, the meter base determines meter form factor. If a new meter is being installed, use meter and base form factor of 9S.

d. Provide meter consisting of a Class 20, transformer rated design.

e. Provide meter that is rated for use at temperature from -40 degrees Centigrade to +70 degrees Centigrade.

f. Meter must have NEMA 3R enclosure for surface mounting.

g. Surge withstand must conform to IEEE C37.90.1.

h. Provide meter with a standard 4 -year warranty.

i. Provide meter in compliance with IEC 62053-22 (Part 21: Static Meter for Active Energy, classes 0.2S and 0.5S), certified by a qualified

third party test laboratory.

2.1.2 Voltage Requirements

a. Furnish meter that is 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. Provide meter that is capable of connection to the service voltage indicated in the Metering System Schedule:

c. Provide meter that accepts independent voltage inputs from each phase and is auto-ranging over the full range of input voltages.

d. Optically isolate voltage input to 2500 volts DC from signal and communications outputs. Use components meeting or exceeding IEEE C37.90.1 (Surge Withstand Capability).

e. The Contractor is responsible for determining the actual voltage ratio of each potential transformer. Provide transformer conforming to IEEE C57.13 and the following requirements.

1. Type: Dry type, of two-winding construction.

2. Weather: Outdoor or Indoor rated for the application.

3. Frequency: Nominal 60Hz, 50Hz for those bases that operate on 50Hz.

4. Accuracy: Plus or minus 0.3% at 60Hz or 0.3% for those systems that operate at 50Hz.

2.1.3 Current Requirements

a. Accept independent current inputs from each phase. Install current transformer with a full load rating as shown in the schedule.

b. Provide single ratio current transformer with an Accuracy Class of 0.3 with a maximum error of +/- 0.3% at 5.0 amps.

c. Current transformer must have:

1. Insulation Class: Provide 600 volt and below current transformers rated at 10 KV BIL. Provide current transformers for 2400 and 4160 volt service rated at 25 KV BIL.

2. Frequency: Nominal 60Hz, 50Hz for bases that operate on 50Hz.

3. Burden: Select burden class for the load.

4. Phase Angle Range: 0 to 60 degrees.

d. Provide meter that accepts current input from standard instrument transformers (5A secondary current transformers.)

e. Current inputs must have a continuous rating in accordance with IEEE C57.13.

f. Provide multi-ratio current transformer where indicated with a top

range equal to or greater than the actual load. The Contractor is responsible for determining the actual ratio of each transformer. Provide current transformer conforming to IEEE C57.13.

2.1.4 Electrical Measurements

Measure and report the following quantities:

a. Kilowatt-hours ("kWh" in Metering Systems Schedule) of consumption. Cumulative.

b. Kilowatts of demand ("kW" in Metering Systems Schedule). Peak average over a selectable demand interval between 5 and 60 minutes (typically 15 minutes).

c. Reactive power ("kVAR" in Metering Systems Schedule). Measured over the same interval as the peak kW reading.

d. Power factor ("PF" in Metering Systems Schedule). Measured over the same interval as the peak kW reading.

e. Time of use consumption ("TOU" in Metering Systems Schedule). Kilowatt-hours recorded separately for each period set by programming into the meter. Time periods must be capable of being changed without removal from service. The meter must internally record and store Time of Use data.

1. Four (4) minimum TOU Rates (Registers)

2. Twenty (20) Year Calendar

3. Two (2) minimum seasons per year

f. Interval recording ("IR" in Metering Systems Schedule). Record kilowatt-hours for each 15 minute interval and accumulate for 30 days. Memory for recording the interval readings must be internal to the meter and ANSI C12.19 compliant. Provide time-stamped readings for every measured parameter.

g. Meter readings must be true RMS.

2.1.5 Meter Accuracy

Provide the following accuracies. Measure accuracies as percent of reading at standard meter test points.

a. Provide power meter meeting ANSI C12.20 for Class 0.2 and IEC 62053-22 accuracy requirements.

2.1.6 An on the Meter Display, Output and Reading Capabilities

Include the following output signals.

a. The meter will have a face display plate and will display every electrical parameter indicated to be recorded. Do not require meters to indicate interval data collected in a data logger with a communications output feature. Display peak values, instantaneous and cumulative values.

2.1.7 Installation Methods

a. Panel mounted. ("PNL" in Metering Systems Schedule)

1. Mount meter where directed. See detail on the drawings.

b. Common features.

1. PTs (if required for proper voltage range) and physically connect CTs to the service entrance cables inside the service entrance disconnect enclosure.

2.1.8 Disconnecting Switches

a. Provide disconnecting wiring blocks between the current transformer and the meter. Build a shorting mechanism into the wiring block to allow the current transformer wiring to be changed without removing power to the transformer. Locate the wiring blocks where they are accessible without the necessity of disconnecting power to the transformer. For multi-ratio current transformers, provide a shorting block from each tap to the common lead.

b. Equip voltage-monitoring circuits with disconnect switches to isolate the meter base or socket from the voltage source.

2.1.9 Meter Programming

a. Provide power meter that is programmable by software supplied by the meter manufacturer.

b. Provide user-friendly software with Windows-compatible interface.

c. Operate software on Windows operating systems.

d. Provide software that allows the user to configure the meter, troubleshoot meter, query and display meter parameters and configuration data and stored values.

e. Provide meter firmware that is upgradeable through one of the communications ports without removing the unit from service.

2.2 COMMUNICATIONS

2.2.1 Communications Methods

2.2.1.1 Optical Port

Communicate with a hand-held reading device according to the following requirements.

a. Communications standards

1. ANSI C12.18

2. MV90 protocol

3. ANSI C12.20

b. Read operations

1. Current kWh values

2. Demand (kW) values since last reset

3. Last reset value

4. Meter status

5. Load profile

c. Write operations

1. Meter setup

2.2.1.2 Serial Port

Provide serial port for connection to modem module where required in this specification.

2.2.1.3 Ethernet

For those meters using the Ethernet, send logged information using open standard Internet Protocols.

a. On-board Ethernet port support

1. HTTP

2. SMTP

(a) Modbus

b. Distribute stored data by

1. FTP

2.2.2 Communications Protocols and Methods

Use communications protocols and methods that are native to the meter. Provide communications module(s) as required to accomplish the following.

a. Include an IR port ("IR" in Metering Systems Schedule) for communication to external devices such as handheld readers that support a minimum speed of 9600 baud.

b. Include or one RS-485 ("RS485" in Metering Systems Schedule) digital communication port. Provide user configurable port with regard to speed, protocol, address, and other communications parameters that support a minimum communication speed of 9600 baud for the RS232 port.

2.2.3 Communications Channels Surge Protection

Protect communications equipment against surges induced on its communications channels. Protect communication interfaces to all field equipment to meet the requirements of IEEE C37.90.1 or the requirements of IEC 61000-4-5, test level 4, while the equipment is operating. Do not use fuses for surge protection. For metallic cables and conductors which serve as communications channels between buildings, install surge

protection at equipment rated for the application at each end, within 3 feet of the building cable entrance. Provide surge protectors meeting the requirements of the applicable extension of ANSI C62 (for example, ANSI C62.61).

2.3 METER DATA PROTOCOL

Provide power meters that have communicating data protocols native or provide in supplemental modules to communicate with the communications methods that follow.

2.3.1 Open Protocol

Support the following open protocols. Verify that the meter native protocol is consistent with the facility data recording and communication and data storage system. Provide additional converters and modules as required for a complete measurement, recording, communicating and data storage system.

a. Provide meter that is fully supported by MV-90 software system or existing AMR software that is MV-90 compatible.

b. For systems that use proprietary software, an alternative, competitive software system must be available.

Systems capable of using more than one brand of commercially available meters are expected. In addition, if proprietary meter reading software is used, meters are to be capable of being read by more than one manufacturer's software.

2.4 SPARE PARTS

2.4.1 Parts List

Provide spare parts as follows:

a. Power meter - two for each type used.

b. Current transformer - three for each type used.

c. Potential transformer - three for each type used.

d. Communications module - one for each type used.

e. Protocol module - one for each type used.

f. Other electronic and power components - one for each type used.

2.5 METERING SYSTEM SCHEDULE

Metering System Schedule is available at http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic

PART 3 EXECUTION

3.1 INSTALLATION

Perform electrical installations conforming to IEEE C2, NFPA 70, 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 govern regarding permission for power outages, scheduling of work, coordination with Government personnel, and special working conditions.

3.2 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 FIELD QUALITY CONTROL

3.3.1 Performance of Acceptance Checks and Tests

3.3.1.1 Meter Assembly

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specification and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.

4. Verify grounding of metering enclosure.

5. Verify the presence of surge arresters.

6. Verify that the CT ratio and the PT ratio are properly included in the meter multiplier or the programming of the meter.

b. Electrical tests

2. Verify that correct multiplier has been placed on face or meter where applicable.

3. Prior to system acceptance, the Contractor will demonstrate and confirm the meter is properly wired and is displaying correct and accurate electrical information.

3.3.1.2 Current Transformers

a. Visual and mechanical inspection

1. Compare equipment nameplate data with specification and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Verify correct connection.

4. Inspect all bolted electrical connections for high resistance using low-resistance ohmmeter, verifying tightness of accessible bolted electrical connections by calibrated torque-wrench method.

5. Verify that 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 test.

3. Perform a polarity test.

4. Perform a ratio-verification test.

3.3.1.3 Potential Transformers

a. Visual and mechanical inspection

1. PT's are rigidly mounted.

2. PT's are correct voltage.

3. Verify that adequate clearances exist between primary and secondary circuit.

b. Electrical tests

1. Perform a ratio-verification test.

3.3.2 Follow-Up System Function Verification

Upon completion of acceptance checks and tests, the 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, give the Contracting Officer 5 working days' advance notice of the dates and times of checking and testing.

3.3.3 Training

Conduct a training course for meter configuration, operation, and maintenance of the system as specified. Orient the training for all components and systems installed under this contract. Deliver training manuals for 2 trainees with two additional copies delivered for archiving at the project site. Furnish all audiovisual equipment and all other training materials and supplies. A training day is defined as eight 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. For guidance in planning the required instruction, assume that attendees have a high school education or equivalent, and are familiar with utility systems. Obtain approval of the planned training schedule from the Government at least 30 days prior to the training.

a. Training: Teach the course at the project site within thirty days after completion of the installation for a period of one day(s). A

maximum of 6 personnel will attend the course. The training includes:

1. Physical layout of each piece of hardware.
2. Meter configuration, troubleshooting and diagnostics procedures.
3. Repair instructions.
4. Preventive maintenance procedures and schedules.
5. Testing and calibration procedures.

-- End of Section --

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COORDINATED POWER SYSTEM PROTECTION

**08/21**

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COORDINATED POWER SYSTEM PROTECTION
**08/21**

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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE 242 | (2001; Errata 2003) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems - Buff Book |
| IEEE 399 | (1997) Brown Book IEEE Recommended Practice for Power Systems Analysis |
| IEEE 1584 | (2002) Guide for Performing Arc-Flash Hazard Calculations |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70E | (2021) Standard for Electrical Safety in the Workplace |

1.2 SYSTEM DESCRIPTION

The power system covered by this specification consists of: low voltage distribution for the renovated portion of the building.

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

Fault Current Analysis

Protective Device Coordination Study

System Coordinator

1.4 QUALITY ASSURANCE

1.4.1 System Coordinator

System coordination, recommended ratings and settings of protective devices, and design analysis must be accomplished by a registered

professional electrical power engineer with a minimum of 3 years of current experience in the coordination of electrical power systems. Submit verification of experience and license number, of a registered Professional Engineer as specified above. Provide experience data consisting of at least five references for work of a magnitude comparable to this contract, including points of contact, addresses and telephone numbers.

## PART 2 PRODUCTS

### 2.1 COORDINATED POWER SYSTEM PROTECTION

Prepare analyses to demonstrate that the equipment selected and system constructed meet the contract requirements for ratings, coordination, and protection. Include a load flow analysis, a fault current analysis, and a protective device coordination study. Submit the study along with protective device equipment submittals. No time extensions or similar contact modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed will be based on recommendations of this study. The Government is not responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study. The studies must be performed by a registered professional engineer with demonstrated experience in power system coordination in the last 3 years. Provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

#### 2.1.1 Scope of Analyses

The fault current analysis and protective device coordination study must begin at: the nearest upstream device in the existing source system and extend through the downstream devices at the load end.

#### 2.1.2 Determination of Facts

Determine and document the time-current characteristics, features, and nameplate data for each existing protective device. Utilize the fault current availability indicated as a basis for fault current studies.

#### 2.1.3 Single Line Diagram

Prepare a single line diagram to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point must have a unique identifier. If a fault-impedance diagram is provided, show impedance data. Show location of switches, breakers, and circuit interrupting devices on the diagram together with available fault data, and the device interrupting rating.

#### 2.1.4 Fault Current Analysis

##### 2.1.4.1 Method

Perform the fault current analysis in accordance with methods described in IEEE 242, and IEEE 399.

2.1.4.2 Data

Utilize actual data in fault calculations. Bus characteristics and transformer impedance must be those proposed. Document data in the report.

2.1.4.3 Fault Current Availability

Provide balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values at each voltage transformation point and at each power distribution bus. Show the maximum and minimum values of fault available at each location in tabular form on the diagram or in the report.

2.1.5 Coordination Study

Demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. Include a description of the coordination of the protective devices in this project. Provide a written narrative describing: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and relay settings. Provide recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction). Provide composite coordination plots on log-log graph paper.

2.1.6 Study report

a. Include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.

b. Include descriptive and technical data for existing devices and new protective devices proposed. Include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.

c. Document existing power system data including time-current characteristic curves and protective device ratings and settings.

d. The report must contain fully coordinated composite time-current characteristics curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. Include recommended ratings and settings of all protective devices in tabulated form.

e. Provide the calculation performed for the analyses, including computer analysis programs utilized. Provide the name of the software package, developer, and version number.

2.2 ARC-FLASH HAZARD ANALYSIS

Comply with NFPA 70E and its Annex D for hazard analysis study.

2.2.1 Contribution Calculations

Calculate maximum and minimum contributions of fault-current size. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.

a. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.

b. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

2.2.2 Locations

Include medium- and low-voltage equipment locations, except equipment rated 240-V ac or less fed from transformers less than 125 kVA.

2.2.3 Safe Working Distances

Safe working distances from calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.

2.2.4 Incident Energy Calculations

Consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. When performing interative calculations, take into account the changing current contributions, as the sources are interrupted or decremented with time. Decremented fault contribution from motors and generators as follows:

a. Fault contribution from induction motors should not be considered beyond three to five cycles.

b. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

2.2.5 Arc-flash Computation

Include both line and load side of a circuit breaker as follows:

a. When the circuit breaker is in a separate enclosure.

b. When the line terminals of the circuit breaker are separate from the work location.

2.2.6 Base Arc-Flash Calculations

Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

2.3 ARC-FLASH WARNING LABELS

Produce a 3.5-by-5-inch therman transfer label of high-adhesion polyester

for each work location included in the analysis. Machine print labels with no field-applied markings. Provide orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

a. Location designation.

b. Nominal voltage.

c. Flash protection boundary.

d. Hazard risk category.

e. Incident energy.

f. Working distance.

g. Engineering report number, revision number, and issue date.

PART 3 EXECUTION

Not Used

-- End of Section --

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ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS

**02/20, CHG 1: 05/21**

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ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS
**02/20, CHG 1: 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.

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 |

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

| | |
|---|---|
| IEC 61000-3-12 | (2012) Electromagnetic Compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and </=75 A per phase |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2020) 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 | (2020) Adjustable-Speed Drives |
| NEMA ICS 7.2 | (2015) Application Guide for AC Adjustable Speed Drive Systems |
| NEMA MG 1 | (2016) Motors and Generators - Revision 1: 2018; Includes 2021 Updates to Parts 0, 1, 7, 12, 30, and 31 |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) 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 61800-5-1 | (2016) Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy |

## 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, IEC 61000-3-12 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

Interconnecting Diagrams

Installation Drawings

As-Built Drawings

SD-03 Product Data

Adjustable Speed Drives

Wires and Cables

Equipment Schedule

SD-06 Test Reports

ASD Test

Performance Verification Tests

Endurance Test

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

ASD Test Plan

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.

Provide one spare ASD of each model provided for HVAC equipment, fully programmed and ready for back-up operation when connected.

### 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. Input circuit breaker per UL 489 with a minimum of 10,000 amps symmetrical interrupting capacity and door interlocked external operator.

b. A converter stage per UL 61800-5-1 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.

c. 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.

d. The ASD shall be capable of supplying 110 percent of rated full load current for one minute at maximum ambient temperature.

e. The ASD must be designed to operate from specified voltage plus or minus 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating.

f. 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.

g. 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.

h. 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.

i. 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.

j. The controller efficiency at any speed must not be less than 96 percent.

k. The controllers must be capable of being restarted into a motor coasting in the forward direction without tripping.

l. 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

m. 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.

n. 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.

o. 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.

p. The ASD must include external fault reset capability. All the necessary logic to accept an external fault reset contact must be

included.

q. 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.

r. Provide preperly 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.

s. 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.

t. Minimum Operating Conditions. Designed and constructed ASD's to operate within the following service conditions:

(1) Ambient Temperature Rating: 0 to 120 degrees F.

(2) Non-condensing relative humidity rating: less than 95 percent.

(3) Ambient rating: Not exceed 3,300 feet.

2.1.1 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:

(1) Running log of total power versus time.

(2) Total run time.

(3) Fault log, maintaining last four faults with time and data stamp for each.

i. The ASD must be capable of automatic control by a remote 0 to 10 VDC signal, by BACnet network command, or manually by the ASD control panel.

j. ASDs must include the following operator programmable parameters:

(1) Upper and lower limit frequency.

(2) Acceleration and deceleration rate.

(3) Variable torque volts per Hertz curve.

(4) Starting voltage level.

(5) Starting frequency level.

(6) Display speed scaling.

(7) Enable/disable soft stall feature.

(8) Motor overload level.

(9) Motor stall level.

(10) Jump frequency and hysteresis band.

(11) PWM carrier frequency.

k. ASD must have the following protective features:

(1) An electronic adjustable inverse time current limit with consideration for additional heating of the motor at frequencies below 45Hz, for the protection of the motor.

(2) An electronic adjustable soft stall feature, allowing the ASD to lower the frequency to a point where the motor will not exceed the full-load amperage when an overload ASD will automatically return to the requested frequency when load conditions permit.

(3) A separate electronic stall at 110 percent ASD rated current, and a separate hardware trip at 190 percent current.

(4) The ability to shut down if inadvertently started into a rotating load without damaging the ASD or the motor.

(5) The ability to keep a log of a minimum of four previous fault conditions, indicating the fault type and time of occurrence in descriptive text.

(6) The ability to sustain 110 percent rated current for 60 seconds.

(7) The ability to shutdown safely or protect against and record the following fault conditions:

(a) Over current (and an indication if the over current was during acceleration, deceleration, or running).

(b) Over current internal to the drive.

(c) Motor overload at start-up.

(d) Over voltage from utility power.

(e) Motor running overload.

(f) Over voltage during deceleration.

(g) ASD over heat.

(h) Load and ground fault.

(h) Abnormal parameters or data in ASD EEPROM.

## 2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, and NEMA ICS 6, with a heater if located outdoors. An HMCP device shall provide the disconnecting means. The operating handle shall protrude through the door, but the disconnect shall not be mounted on the door. The handle shall indicate ON, OFF, and tripped conditions. The handle shall have provisions to accommodate a minimum of three padlocks in the OFF position. Interlocks shall prevent unauthorized opening or closing of the ASD door with the disconnect handle in the ON position. The door handle interlock should have provisions to be defeated by qualified maintenance personnel.

## 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 with the assistance of a factory-authorized service representative.

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 --

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DIVISION 26 - ELECTRICAL

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM

**11/13**

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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; TIA 22-1; ERTA 1 2022) National Electrical Code |
| NFPA 780 | (2023) Standard for the Installation of Lightning Protection Systems |

U.S. AIR FORCE (USAF)

| | |
|---|---|
| AFI 32-1065 | (2017) Grounding Systems |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 96 | (2016) UL Standard for Safety Lightning Protection Components |
| 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-RO

Each major component; G-RO

SD-06 Test Reports

Lightning Protection and Grounding System Test Plan; G-RO

Lightning Protection and Grounding System Test; G-RO

SD-07 Certificates

Lightning Protection System Installers Documentation; G-RO

Component UL Listed and Labeled; G-RO

Lightning protection system inspection certificate; G-RO

Roof manufacturer's warranty; G-RO

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 and AFI 32-1065. 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 and AFI 32-1065. In either case, AFI 32-1065 takes precedence over NFPA 780, whether or not it is more stringent.

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 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 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.

2.2.3 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, grounding electrodes and ground ring electrode conductor. 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

Use adhesive shoes with adhesive approved by the roof manufacturer when installing air terminals on "rubber" (EPDM) type roofs. 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.

3.1.1.2 Roof Conductors

Use adhesive shoes with adhesive approved by the roof manufacturer when installing roof conductors on "rubber" (EPDM) type roofs.

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 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

3.4 RESTORATION

Where sod has been removed, place sod as soon as possible after completing the backfilling. Restore, to original condition, the areas disturbed by trenching, storing of dirt, cable laying, and other work. Overfill to accommodate for settling. Include necessary topsoil, fertilizing, liming, seeding, sodding, sprigging or mulching in any restoration. Maintain disturbed surfaces and replacements until final acceptance.

3.5 FIELD QUALITY CONTROL

3.5.1 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 --

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DIVISION 26 - ELECTRICAL

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GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM

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GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM
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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.

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 B16.5 | (2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard |
| ASME B16.21 | (2021) Nonmetallic Flat Gaskets for Pipe Flanges |
| 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 | (2022) Nuts for General Applications: Machine Screw Nuts, and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series) |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A194/A194M | (2022) 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 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 B843 | (2018) Standard Specification for Magnesium Alloy Anodes for Cathodic Protection |
| ASTM C94/C94M | (2021b) Standard Specification for Ready-Mixed Concrete |
| ASTM D709 | (2017) Standard Specification for Laminated Thermosetting Materials |
| ASTM D2028/D2028M | (2015) Cutback Asphalt (Rapid-Curing Type) |
| ASTM D3381/D3381M | (2018) Standard Specification for Viscosity-Graded Asphalt Binder for Use in Pavement Construction |

NACE INTERNATIONAL (NACE)

| | |
|---|---|
| NACE SP0106 | (2018) Control of Internal Corrosion in Steel Pipelines and Piping Systems |
| NACE SP0169 | (2013) Control of External Corrosion on Underground or Submerged Metallic Piping Systems |
| NACE SP0177 | (2019) Mitigation of Alternating Current and Lightning Effects on Metallic Structures and Corrosion Control Systems |
| NACE SP0188 | (1999; R 2006) Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates |
| NACE SP0286 | (1997; R 2007) Standard Practice Electrical Isolation of Cathodically Protected Pipelines |
| NACE SP21424 | (2018) Alternating Current Corrosion on Cathodically Protected Pipelines: Risk Assessment, Mitigation and Monitoring |
| NACE TPC 11 | (2008) A Guide to the Organization of Underground Corrosion-Control Coordinating Committees |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| ANSI C119.1 | (2016) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts |
| NEMA ICS 6 | (1993; R 2016) Industrial Control and Systems: Enclosures |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| MIL-I-1361 | (1985; Rev C; Notice 1 1991; Notice 2 2021) Instrument Auxiliaries, Electrical Measuring: Shunts, Resistors and Transformers |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 6 | (2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel |
| UL 510 | (2020) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape |

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 Drawings

Drawings within this specification refers to the drawings prepared by the cathodic engineer as part of the submittal for this specification.

1.2.2 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.

1.2.3 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.

### 1.2.4 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.

### 1.2.5 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.

### 1.2.6 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.

### 1.2.7 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.

### 1.2.8 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.

### 1.2.9 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.

### 1.2.10 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.

1.2.11 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.

1.2.12 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.

1.2.13 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.

1.2.14 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.

1.2.15 Error-Free

Potential measurement error due to a voltage drop caused by current flowing through a resistor (the electolyte) between the reference electrode and the protected structure.

1.3 ADMINISTRATIVE REQUIREMENTS

After award of the contract, but prior to commencement of any work at the site, meet with the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Develop a mutual understanding relative to the administration of the value engineering, the safety program, preparation of the schedule of prices or the earned value report. Review shop drawings, and other submittals, scheduling programming, execution of the work, and clear expectations of the "Interim Department of Defense (DD) Form 1354" submittal. Major subcontractors who will engage in the work must also attend.

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 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

Preconstruction Survey

SD-02 Shop Drawings

Drawings; G-AE

Isolation flange kits

Anode junction boxes, bonding boxes, and test stations

Joint bonds

Contractor's Modifications; G-AE

SD-03 Product Data

Qualifications

Equipment

Anodes

Anode junction boxes, bonding boxes, and test stations

Dielectric unions

Wires

Cable and wire

Casings, isolation, and seals

Shunts

Permanent reference electrodes; G-RO

Spare Parts

SD-06 Test Reports

Tests and Measurements; G-RO

Contractor's Modifications; G-RO

SD-10 Operation and Maintenance Data

Cathodic Protection System; G-RO

Training Course; G-RO

SD-11, Closeout Submittals

Initial Cathodic Protection System Field Testing; G-RO

One Year Warranty Period Cathodic Protection System Field Test Report; G-RO

Final Cathodic Protection System Field Test Report; G-RO

1.4.1 Material and Equipment Manufacturer Data

| DATE | ISSUE NO. | REQUEST DATE | REQUESTED BY | REQUEST REF. NO. |
|---|---|---|---|---|
| | | | | |
| MANUFACTURER NAME | | | | |
| | | | | |
| DESCRIPTION OF EQUIPMENT | | | | |
| | | | | |

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

### 1.5.1 Spare Parts

After approval of shop drawings, furnish spare parts data for each different item of material and equipment specified. The data must include a complete list of parts, special tools, and supplies, with current unit prices and source of supply.

After approval of shop drawings, furnish revised spare parts for any changes made from original submittal. One spare anode of each type must be furnished. In addition, supply information for material and equipment replacement for all other components of the complete system, including anodes, cables, splice kits and connectors, corrosion test stations, and any other components not listed above. Furnish one reference electrode on a hand reel with 350 feet of conductor, one digital voltmeter that can be used in the maintenance of this CP system. Demonstrate use of furnished equipment in actual tests during the training course. Provide a description of equipment of the pipe-to-soil protected structure and foreign structures at electrical isolation between the utility supplier and the facility piping.

### 1.5.2 Extra Materials

Furnish one reference electrode on a hand reel with350 feet of conductor, one high-input-impedance digital multimeter that can be used in the maintenance of this CP system. Demonstrate use of furnished equipment in actual tests during the training course. Provide a description of equipment of the pipe-to-soil protected structure and foreign structures at electrical isolation between the utility supplier and the facility piping. Include a description of the equipment and measurement of the pipe-to-soil potentials, anode voltage, anode current and soil condition.

## 1.6 QUALITY CONTROL

### 1.6.1 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.

### 1.6.2 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 who has experience in CP of the type of CP system being installed. The corrosion expert must have not less than five 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.

1.6.3 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.

1.7 DELIVERY, STORAGE AND HANDLING

Storage area for corrosion materials will be designated by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. If materials are not stored in a building, tarps or similar protection must be used to protect material from inclement weather. Resack and add backfill to packaged anodes that are damaged as a result of improper handling or exposure to rain.

1.8 PROJECT/SITE CONDITIONS

1.8.1 Environmental Requirements

1.8.2 Existing Conditions

Prior to start of any onsite construction activities, perform a Preconstruction Survey of the project site with the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager, 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), as applicable. The Contractor and the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager 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.

1.9 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 Corrosion Control System Description

A corrosion control system consists of several systems which work together to mitigate corrosion on buried or submerged metallic structures. Failure to comply with the requirements of any one of these systems may result in inadequate corrosion control and premature failure of the structure being protected. Each system's guide specifications must be included in the design and installation of a complete corrosion control system and must be adhered to in the design and execution of the corrosion control of a structure being protected. Determination of Need for CP must be made by government requirements and policy directives.

a. Construction Design Requirements (CDR) for protected structures are found in the UFGS for the structure being protected.

b. Coating Systems (CS) are a critical factor in performance of a GACP system. All coatings, including coatings in structure guide specifications and Green Seal (GS) coatings, must be compatible with the structure and the CP system, and have high disbondment capabilities. A high resistance to cathodic disbondment is critical for long term service life of coatings on buried or submerged metallic structures under CP. For paints and coatings refer to Section 09 90 00 PAINTS AND COATINGS, and for discontinuity (Holiday) testing of new protective coatings on conductive substrates refer to NACE SP0188.

c. Mechanical Damage Systems (MDS) such as bedding and rock control barriers normally included in Structure GS may be required by design for some locations. Electrical Isolation is required for all galvanic anode CP systems. For an Electrical Isolation System (EIS) refer to NACE SP0286.

d. An Electrical Continuity System (ECS) of the protected structure is critical to the operation of the CP system. The types of joints such as bonding and couplings are normally included in Structure GS, this is particularly important to nonwelded pipelines to allow sufficient CP current to conduct to the entire structure.

e. Stray Current (Interference) Systems must be considered in design, monitored during construction, and interference testing must be completed during the final testing. Design must consider all other cathodic protection systems which may affect other systems or systems which may affect the project, including foreign systems. All foreign systems must be contacted for information and notification and any joint testing which may be required. Corrosion Coordinating Committees may exist. Reference NACE TPC 11.

f. Pipelines that parallel overhead high voltage AC transmission power systems are subject to induced AC. Induced AC has several potential adverse impacts on the safety of personnel and pipeline integrity. Assuming that these conditions exist, there are several measures that can be taken to mitigate the induced AC present on a pipeline. These

induced AC mitigation strategies are detailed in various international standards including NACE SP0177.

g. Galvanic Anode CP Monitoring System is a solution for remote monitoring (and optionally controlling) different kinds of galvanic anode CP applications, mainly to protect underground pipelines used in oil and gas distribution systems, but the same system can be used to monitor other galvanic anode CP applications like tank farms and oil platforms. These Monitoring Systems are detailed in various international standards including NACE TPC 11.

h. When a project is connecting to an existing infrastructure with CP the design must be compatible with the existing structure(s) CP system. Existing structures may have Impressed Current CP (ICCP) Anode Systems using Remote Anode Systems, Deep Anode Systems, Linear Anode Systems, or Distributed Anode Systems. Existing structures may also have Galvanic CP (GACP) Systems which may be distributed or remote. Existing structures might not have CP. They may use alternative methods of corrosion mitigation instead of CP such as Inhibitor System/Internal Corrosion Control. For control of internal corrosion in steel pipelines and piping systems refer to NACE SP0106. Due to the limited voltage and current of galvanic anodes the protected structure must be coated and isolated from other structures.

i. A highly dielectric bonded coating is required to attain adequate CP. Unbonded coatings block the protective current from the pipeline or structure and must not be used with CP. Failure to isolate other metallic structures will result in loss of protection. Isolation from other metallic structures must be maintained.

j. Continuity of the structure with low resistance is crucial to proper operation of a galvanic anode system. All joints must be continuous or be bonded to both sides of the joint.

k. A conductive electrolyte is required to allow current flow from the galvanic anodes. Use of galvanic anode systems are normally restricted to electrolytes with resistivities below 30,000 ohm-cm. Small well coated structures such as coated valves, tees and elbows have very high resistance to earth in high resistance soils. Galvanic anodes in electrolytes over 30,000 ohms also have very high resistance to earth. High circuit resistance with the low voltage of galvanic anodes will not allow sufficient current to meet instant off or depolarization criteria. Additional anodes under these conditions will not noticeably increase the current applied to the structure. Reference NACE SP0169 for criteria in high resistance electrolytes.

### 2.1.2 Design Requirements

#### 2.1.2.1 Electrical Isolators

Isolators are required to isolate the pipes from any other structure. Provide isolators at all locations where the indicated pipes contact any other metallic structure. Provide locations and detailed drawings of required installations. Include any requirements for lightning protection, test stations, surge protection, or other requirements and include locations and details in design drawings.

2.1.2.2 Anode and Bond Wires

Provide a minimum of 5 magnesium anodes with an unpackaged weight of 32 pounds with test stations at locations as shown in the drawings. Provide these anodes in addition to anodes for the pipe under concrete slab and casing requirements. For each cathodic system, provide metallic components and structures that are electrically continuous by installing bond wires between the various structures. Bonding of existing buried structures may also be required to preclude detrimental stray current effects and safety hazards. Return stray current to its source without damaging structures intercepting the stray current. Provide electrical isolation of underground facilities in accordance with acceptable industry practice. All tests must be witnessed by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager.

2.1.2.3 Non-metallic Pipe System

In the event pipe other than metallic pipe is approved and used in lieu of metallic pipe, protect all metallic components of this pipe system with CP. Submit detailed drawings of CP for each component to the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager for approval within 45 days after date of receipt of notice to proceed, and before commencement of any work.

2.1.2.4 Coatings

Provide coatings for metallic components as required for metallic fittings. Complete and test protective coating on each metallic component (such as valves, hydrants and fittings). Provide coating as required for underground metallic pipe. Each test must be witnessed by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Select, apply, and inspect coatings as specified in these specifications. The use of non-metallic pipe does not change other requirements of the specifications. Submit any deviations due to the use of non-metallic pipe for approval.

2.1.2.5 Tracer Wire

When a non-metallic pipeline is used to extend or add to an existing metallic line, exothermic-weld No. 8 AWG copper wire with THHN insulation to the existing metallic line and run the length of the new non-metallic line. Use this wire as a locator tracer wire and to maintain continuity to any future extensions of the pipeline.

2.1.2.6 Drawings

Submit six copies of detail drawings consisting of a complete list of equipment and material including manufacturer's descriptive and technical literature, catalog cuts, contractor's modifications, results of system design calculations including soil-resistivity, installation instructions and certified test data showing location of anodes and stating the maximum recommended anode current output density. Include in the detail drawings complete wiring and schematic diagrams, isolation fittings, test stations, permanent reference electrodes and bonding and any other details required to demonstrate that the system has been coordinated and will function properly as a unit. Reference locations to two permanent facilities or mark points. Provide one electronic PDF copy and digital photos of the completed installation.

2.1.2.7 Summary of Services Required

Include the following scope of services:

a. Close-interval potential surveys,

b. CP Installation System,

c. System testing,

d. Casing corrosion control,

e. Interference testing,

f. Training,

g. Operating and maintenance manual,

h. Isolation testing and bonding testing,

i. Coating and holiday testing.

2.1.2.8 Tests of Components

Perform a minimum of four tests at each metallic component in the piping system. Two measurements must be made directly over the anodes and the other two tests must be over the outer edge of the component, but at the farthest point from the anodes. Provide a field drawing showing the component, the structure, all components of the CP system and their relationship to each other. Also provide a narrative describing how the CP system will work and the testing at each component. Components requiring CP must include but not be limited to the following:

a. Pipes beneath the floor slab or foundations.

b. Post Indicator Valve (PIV).

c. Shutoff valves.

d. Metallic pipes extended from aboveground locations.

e. Connectors or change-of-direction devices.

f. Metallic pipe components or sections.

g. Backflow preventers.

h. Culverts.

i. Casings.

2.1.2.9 Electrical Potential Measurements

Make all potential tests at a minimum of 10 foot intervals witnessed by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Provide submittals identifying test locations on separate drawings, showing all metal to be protected and all CP equipment. Distinguish and identify test points, equipment, and protected metal.

2.1.2.10 Typical Metallic Components on Non-metallic Systems

2.1.2.10.1 Metallic Components

As a minimum, protect each metallic component with two galvanic anodes. This number of anodes is required to achieve minus 850 millivolts "instant off" potential on the metallic area and at the same time not provide overvoltage above 1200 millivolts "instant off." As a minimum, the galvanic anode unpackaged weight must be 32 pounds. Locate the galvanic anodes on each side of the metallic component and route through a test station.

2.1.2.10.2 Fire Hydrants

Provide fire hydrant pipe components with a minimum of two anodes. These galvanic anodes must have an unpackaged weight of 32 pounds.

2.1.2.10.3 Pipe Beneath Concrete Slab

Pipe beneath concrete slab must have a minimum of 2 galvanic anodes. These galvanic anodes must have an unpackaged weight of 32 pounds. Pipe beneath concrete slab must have 1 permanent reference electrodes located beneath the slab. Locate one permanent reference electrode where the pipe enters the concrete slab. Route all conductors to a test station.

2.1.2.10.4 Valves

Protect each valve with 2 galvanic anodes. The galvanic anode must have an unpackaged weight of 32 pounds.

2.1.2.10.5 Connectors or Change-of-Direction Devices

Protect each change-of-direction device with 2 galvanic anodes. The galvanic anode must have an unpackaged weight of 32 pounds.

2.1.2.11 Metallic Component Coating

Coatings for metallic components will be required for metallic fittings as indicated. These metallic fittings will include fire hydrants, tees, elbows, and valves. Coatings must be selected, applied, and inspected as specified in the coating specifications referenced and be compatible with the structure being protected. All coatings must be in accordance with all applicable Federal, State, and local regulations. Unbonded coatings must not be used with CP.

2.1.2.12 Location of Test Stations

Provide test stations of the type and location shown and curb box mount. Provide buried isolation joints with test wire connections brought to a test station. Reference all test stations with GPS coordinates. Unless otherwise shown, locate other test stations as follows:

a. At 1,000-foot intervals or less.

b. Where the pipe or conduit crosses any other metal pipe.

c. At both ends of casings under roadways and railways.

d. Where both sides of an isolation joint are not accessible above ground for testing purposes.

2.1.2.13 Electrical Isolation of Structures

As a minimum, provide isolating flanges or unions at the following locations:

a. Connection of new metallic piping or components to existing piping.

b. Pressure piping beneath floor slab to a building.

Provide isolation at metallic connection of all lines to existing system and where connecting to a building. Additionally, provide isolation between water or forced main line; and foreign pipes that cross the new lines within 10 feet. Install isolation fittings, including isolating flanges and couplings, aboveground or in a concrete pit.

2.1.2.13.1 Gas Distribution Piping

Provide electrical isolation at each building riser pipe to the pressure regulator, at all points where a short to another structure or to a foreign structure may occur, and at other locations as indicated on the drawings.

2.1.2.13.2 Isolation Joint Testing

An isolator checker or insulation tester will be used for isolation or insulating joint (flange or dielectric) electrical testing.

2.1.2.13.3 Underground Structure Coating

This coating specification takes precedence over any other project specification and drawing notes, whether stated or implied, and also applies to the pipeline or tank supplier. Variance in coating quality is not allowed by the contractor or Base Construction Representative without the written consent of the designer. All underground metallic pipelines and tanks to be cathodically protected must have a high quality factory-applied coating. This includes all carbon steel, cast-iron and ductile-iron pipelines or vessels. Select, apply, and inspect coatings as specified. If non-metallic pipelines are installed, coat all metallic fittings on pipe sections in accordance with this specification section.

a. The nominal coating thickness for the metallic pipe joint or other component coating must be 16 mils, plus or minus 5 percent.

b. Apply pipe and joint coating for factory applied or field repair material as recommended by the manufacturer. Coating must be one of the following:

(1) High density polyethylene/bituminous rubber compound tape.
(2) Coal tar epoxy.

2.1.2.13.4 Field Joints

Coat all field joints with materials compatible with the pipeline coating compound. Apply the joint coating material to an equal thickness as the pipeline coating. Do not use unbonded coatings for these buried metallic components. This includes the elimination of all unbonded polymer wraps

or tubes. Once the pipeline or vessel is set in the trench, conduct an inspection of the coating. This inspection must include electrical holiday detection. Repair any damaged areas of the coating. The Contracting Officer or the Contracting Officer's Representative, Technical Expert or Project Manager must be asked to witness inspection of the coating and testing using a holiday detector.

2.1.2.13.5 Inspection of Pipe Coatings

Any damage to the protective coating during transit and handling must be repaired before installation. After field coating has been applied, inspect the entire pipe using an electric holiday detector in accordance with NACE SP0188 using a full-ring, spring-type coil electrode. The holiday detector must be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Upon detection, immediately repair all holidays in the protective coating. Occasional checks of holiday detector, operation will be made by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager to determine suitability of the detector. Provide all labor, materials, and equipment necessary for conducting the inspection.

2.1.2.13.6 Protective Coating for Aboveground Piping System

Provide finish painting conforming to the applicable paragraph of Section 09 90 00 PAINTS AND COATINGS and as follows:

2.1.2.13.7 Ferrous Surfaces

Touch-up shop-primed surfaces with ferrous metal primer. Solvent-clean surfaces that have not been shop-primed. Surfaces that contain loose rust, loose mill scale, and other foreign substances must be mechanically-cleaned by power wire-brushing and primed with ferrous metal primer. Finish primed surface with two coats of exterior oil paint and vinyl paint.

2.1.3 Performance Requirements

The design must allow for synchronized interruption of all applied current.

2.1.3.1 Criteria of Cathodic Protection

The design must allow for synchronized interruption of all applied current. All galvanic anode leads, or header cables, must be connected to the protected structure through test stations or junction boxes and must never be connected directly to the protected structure.

a. Determination of the on and polarized (instant off) potentials must be made with the protective current applied to the pipeline for a minimum of 4 days. 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 96 hours after the interruption of protective current.

2.1.3.1.1 Steel

A negative polarized potential of 0.85 volts (850 millivolts) or more negative. The voltage must not be more negative than a negative polarized potential of 1.200 volts (1200 millivolts).

2.1.3.1.2 Aluminum

Aluminum underground component must not be protected to a potential more negative than minus 1200 millivolts, measured between the underground component and a saturated copper/copper sulfate reference electrode contacting the earth, directly over the metallic component. Resistance, if required, must be inserted in the anode circuit within the test station to reduce the potential of the aluminum to a value which will not exceed a potential more negative than minus 1200 millivolts. Voltage shift criterion must be a minimum negative polarization shift of 100 millivolts measured between the metallic component and a saturated copper/copper sulfate reference electrode contacting the earth, directly over the metallic component. The polarization voltage shift must be determined as outlined for iron and steel.

2.1.3.1.3 Copper Piping

For copper piping, the following criteria must apply: A minimum of 100 millivolts of cathodic polarization between the structure surface and a stable reference electrode contacting the electrolyte. The polarization voltage shift must be determined as outlined for iron and steel.

2.2 EQUIPMENT

2.2.1 Remote Monitoring

Remote monitoring equipment must be designed, manufactured and procured specifically for cathodic protection use and must be provided as per design and drawings to monitor potential (requires permanent reference electrode) and must match or be compatible with previously installed remote monitoring equipment in use at the installation.

2.2.2 Corrosion Rate Monitoring

Corrosion probes must be designed, manufactured and procured specifically for the application and matched to the structure being protected. Manufacturer must match or be compatible with previously installed rate monitoring equipment in use at the installation.

2.2.3 Solid State Decoupler (SSD)

SSDs must be designed, manufactured, and procured specifically for the application and must exceed the modeled AC steady-state current and fault conditions. For Hazardous locations, the PCRH model must be used. SSDs must be installed with a protective ground-based enclosure to secure the cable connections and prevent electrical hazards.

| Characteristic | SSD |
|---|---|
| AC steady-state current, rms | 45A |
| AC fault current, rms. at 0.5s | 1.2 to 5 kA |
| Lightning current, 8x20micros, peak | 75-100 kA |
| Hazardous location certification | Division 2, Zone 2 |
| Rain Proof, IP66 | Yes |
| Submersible, IP68 or NEMA 6P | Yes |

2.3 COMPONENTS

2.3.1 Test Stations

2.3.1.1 Flush Mounted

NEMA ICS 6. Metallic or non-metallic with terminal board, 8 terminal posts and lockable lid. A non-metallic enclosure must be molded of glass filled polycarbonate and urethane coated or Acrylonitrile Butadiene Styrene (ABS) plastic . 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 316 stainless steel hardware. The terminal board must be removable for easy access to wires. Provide traffic valve box capable of withstanding H-20 traffic loads. The cover must have a cast in legend "CP TEST."

2.3.2 Shunts for Test Stations and Junction Boxes

MIL-I-1361. 0.01 ohm, 2 ampere, accuracy plus or minus one percent, polycarbonate circuit board type, color coded for value recognition yellow for 0.01 ohm shunt with nickel-plated brass posts and standard 0.25 inch inch holes on 1 inch centers to fit test stations and terminal boards 0.01 ohm 6 ampere, accuracy plus or minus one percent, manganin wire type.

2.3.3 Junction Box Enclosures

NEMA ICS 6, Type 3R enclosure with clamped cover Type 316 stainless steel hinges and clamped cover. Enclosure must be of galvanized steel construction with terminal board. Knockout for conduit must be the size and location as per design drawings.

2.3.3.1 Nameplates

Provide nameplate in accordance with Section26 20 00 INTERIOR DISTRIBUTION

SYSTEM and ASTM D709. Provide laminated plastic nameplates for each enclosure as specified or as indicated on the drawings. Each nameplate inscription must identify the function. Nameplates will be melamine plastic, 0.125 inch thick, white with black center core. Surface will be matte finish. Corners will be square. Accurately align lettering and engrave into the core. Minimum size of nameplates must be 25 inch by 2.5 inches. Lettering must be a minimum of 0.25 inch high normal block style.

2.3.4 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).

2.3.5 Anode Junction Boxes

2.3.5.1 Enclosure

NEMA ICS 6, Type 3R enclosure with clamped cover Type 316 stainless steel hinges and clamped cover. Enclosure must be of galvanized steel construction with terminal board and labeled with nameplate. Provide nameplate in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.3.5.2 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, and reference electrodes).

2.4 MATERIALS

2.4.1 Galvanic Anodes

2.4.1.1 Dimensions and Weights

Bare anode weight 32 pounds not including core.

2.4.1.2 High Potential Magnesium Anodes

Install a minimum of 12 anodes on the Pipe system. See Paragraph METALLIC COMPONENTS ON NON-METALLIC SYSTEMS AND TYPICALS for additional anodes under slab.

2.4.1.2.1 Anode Composition

Anodes must be of high-potential magnesium alloy, made of primary magnesium obtained from sea water or brine, and not made from scrap

metal. Magnesium anodes must conform to ASTM B843 and to the following analysis (in percent) otherwise indicated:

| | |
|---|---|
| Aluminum | 0.010 percent |
| Manganese | 0.50 to 1.30 percent max |
| Zinc | 0.05 percent max |
| Silicon | 0.05 percent max |
| Copper | 0.02 percent max |
| Nickel | 0.001 percent max |
| Iron | 0.03 percent max |
| Other impurities | 0.05 each or 0.3 percent max total |
| Magnesium | Remainder |

Furnish spectrographic analysis on samples from each heat or batch of anodes used on this project.

2.4.1.2.2 Dimensions and Weights

The following dimensions and weights of anodes are not all inclusive and are presented as examples, various manufacturers may have additional sizes not included in the following table:

a. Bare anode weight: 32 pounds not including core.

**Typical Magnesium Anode Size (may be round, square, or D shaped)**

| Nominal Weight Bare | | Approximate Size | | | | | | Packaged Weight | | Nominal Packaged Dimensions | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Width | | Height | | Length | | | | Diameter | | Length | |
| kg | lbs | mm | inch | mm | inch | mm | inch | kg | lbs | mm | inch | mm | inch |
| | 32 | | 5.5 | | 5 | | 20.5 | | 70 | | 8 | | 28 |

2.4.2 Wire and Cable

2.4.2.1 Anode Lead Wire

Wire must be No. 12 AWG solid copper wire, not less than 10 feet long, without any splices, complying with HMWPE insulation. Connecting wires for magnesium anodes will be factory installed with the place or emergence from the anode in a cavity-sealed flush with a dielectric sealing compound.

2.4.2.2 Anode Header Cable

Cable for anode header and distribution will be No. 2 AWG stranded copper wire with type CP HMWPE, 7/64 inch thick insulation, 600-volt rating.

2.4.2.3 Structure (Negative) Cable

Structure connecting wire must be No. 4 AWG stranded copper wire with type CP high molecular weight insulation, 7/64 inch thick insulation, 600 volt rating. Copper conductors conforming to ASTM B3 and ASTM B8.

2.4.2.4 Test Wires

Test wires must be No. 12 AWG stranded copper wire with insulation. Copper conductors conforming to ASTM B3 and ASTM B8.

2.4.2.5 Joint and Continuity Bond Cables

Provide bonds across joints or any electrically discontinuous connections in the piping, and other pipes and structures with other than welded or threaded joints included in this CP system. Unless otherwise specified, bonds between structures and across joints in pipe with other than welded or threaded joints must be with No. 4 AWG stranded copper cable with polyethylene insulation. Bonds between structures must contain sufficient slack for any anticipated movement between structures. Bonds across pipe joints must contain a minimum of 4 inch of slack to allow for pipe movement and soil stress. Bonds must be attached by exothermic welding. Exothermic weld areas must be insulated with coating compound and approved by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Continuity bonds must be installed as necessary to reduce stray current interference. Additional joint bonding must be done where determined during construction or testing or as directed. Joint bonding must include excavation and backfilling. There must be a minimum of 2 continuity bonds between each structure and other than welded or threaded joints. Electrical continuity must be tested across joints with other than welded or threaded joints and across metallic portions of sewage lift stations and water booster stations. Copper conductors conforming to ASTM B3 and ASTM B8.

2.4.2.6 Resistance Bond Wires

Resistance bonds must be adjusted for minimum interference while achieving the criteria of protection. Alternate methods may be used when approved.

2.4.3 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.

2.4.4 AC Mitigation Materials

If required, AC mitigation materials typically consist of a mitigation material either zinc ribbon or copper cable, interconnecting coated copper cables, solid state decouplers to control the AC current flow and test stations.

2.4.5 Backfill Material

The backfill material must have the following composition, unless otherwise indicated:

| Material | Approximate Percent by Weight |
|---|---|
| Gypsum | 75 |
| Bentonite | 20 |
| Sodium Sulfate | 5 |
| Total | 100 |

2.4.6 Permanent Reference Electrodes

Permanent reference electrodes must be copper/copper-sulfate specifically manufactured for underground use, 1 1/4 inch diameter, by 8 inches long, plastic tube with an ion trap to minimize contamination of the electrode. 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. The electrode will be prepackaged by the manufacturer with a backfill material as recommended by the manufacturer. Provide electrodes with No. 12 AWG, RHW cable of sufficient length to extend to the test station or junction box 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.

2.4.7 Pavement Inserts

Pavement insert must be a non-metallic flush type test station without terminal board, and must allow a copper/copper sulfate reference electrode to contact the electrolyte beneath the pavement surface. Provide traffic valve box capable of withstanding H-20 traffic loads.

2.4.8 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.

2.4.9 Isolation Flange Kits

Provide full-faced gaskets, isolating sleeves and washers, and steel washers. Provide isolation flange kits rated for operation at the rated pressure and temperature.

2.4.9.1 Gaskets

ASME B16.21. Neoprene faced phenolic material for operation at 120 psi, 450 degrees F.

2.4.9.2 Isolating Washers and Sleeves

Two sets 1/8 inch laminated phenolic for operation at 450 degrees F.

Isolating washers must fit within the bolt facing on the flange over the outside of the fabric reinforced phenolic sleeve.

2.4.9.3 Washers

Steel, cadmium plated, to fit within the bolt facing on the flange.

2.4.10 Steel Flanges and Bolting

2.4.10.1 Steel Flanges

ASME B16.5, 150 lb. .

2.4.10.2 Bolting

ASTM A307, Grade B for bolts; ASTM A194/A194M, Grade 2 for nuts. Dimensions: ASME B18.2.1 for bolts, ASME B18.2.2 for nuts. Threads: ASME B1.1, Class 2A fit for bolts, Class 2B fit for nuts. Bolts must extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at the roof of threads.

2.4.11 Dielectric Unions

ASME B16.39, Class 1 for dimensional, strength, and pressure requirements. Insulation barrier must limit galvanic current to one percent of the short-circuit current in a corresponding metallic joint. Provide insulating material impervious to water.

2.4.12 Isolation and End Seals

2.4.12.1 Casing Isolator/Centralizer

High density (linear), injection molded virgin Polyethylene positive electrical isolation, high abrasion resistance and low coefficient of friction.

2.4.12.2 End Seals

Ethylene Propylene Diene Monomer (EPDM) Neoprene rubber end seals, thickness of 1/8 inch or more, with 2 Stainless Steel Pipe Clamps per end seal, 1/8 inch thick and 1/2 inch wide or more.

2.5 ACCESSORIES

2.5.1 Conduit

UL 6, rigid galvanized steel.

2.5.2 Joint, Patch, Seal, and Repair Coating

Sealing and dielectric compound must be a black, rubber based compound that is soft, permanently pliable, tacky, moldable, and unbacked. Compound will be applied as recommended by the manufacturer, but not less than 1/2-inch thick. Coating compound must be cold-applied coal-tar base mastic. Pressure-sensitive vinyl plastic electrical tape and rubber insulated tape must conform to UL 510.

2.5.3 Underground Splices

Provide splices with a compression connector on the conductors, and insulation and waterproofing using one of the following methods which are suitable for continuous submersion in water and comply with ANSI C119.1.

2.5.3.1 Cast-Type Splice

Provide cast-type splice insulation by means of molded casting process employing a thermosetting epoxy resin insulating material applied by a gravity poured method or pressure injected method. Provide component materials of the resin insulation in a packaged form ready for convenient mixing without removing from the package.

2.5.3.2 Gravity-Poured Splice

Gravity-poured method must employ materials and equipment contained in and approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare the resin mix and pour into the mold.

2.5.3.3 Heat Shrinkable Splice

Provide heavy wall heat shrinkable splice insulation by means of a thermoplastic adhesive sealant material which must be applied by a clean burning propane gas torch.

2.5.4 Electrical Isolation of Structures

2.5.4.1 Electrically Isolating Pipe Joints

Electrically isolating pipe joints will be of a type that is in regular factory production.

2.5.4.2 Electrically Isolating Couplings

Electrically isolating couplings will be of a type that has a published maximum electrical resistance rating given in the manufacturer's literature. Cradles and seals will be of a type that is in regular factory production made for the purpose of electrically isolating the carrier pipe from the casing and preventing the incursion of water into the annular space.

2.5.5 Electrical Insulating Coating

Heat-shrinkable tape.

2.5.6 Buried Cable Warning and Identification Tape

Polyethylene tape, manufactured for warning and identification of buried cable and conduit. Tape must be 3 inches wide, Yellow in color and read "Caution Buried Cable Below" or similar. Color and lettering must be permanent and unaffected by moisture or other substances in backfill materials.

2.5.7 Electrical Connection to Structures

2.5.7.1 Exothermic Welds

Electrical connections to metallic structures must be made using exothermic welds in strict accordance with the manufacturer's recommendations.

2.5.7.2 Electrical-Shielded Arc Welds

Electrical-shielded arc welds must be approved for use on steel pipe by shop drawing submittal action.

2.5.7.3 Brazing

Brazing will be as specified by manufacturer using specialized equipment designed for that purpose.

2.5.8 Electrical Tape

Pressure-sensitive vinyl plastic electrical tape and rubber insulated tape must conform to UL 510.

2.5.9 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).

2.6 TESTS, INSPECTIONS, AND VERIFICATIONS

2.6.1 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/CuSO4 Reference Electrode** |
|---|---|
| High Potential Magnesium | More Negative than Negative 1.65 Volts DC |
| Standard Magnesium | More Negative than Negative 1.4 Volts DC |
| Zinc | More Negative than Negative 1.0 Volts DC |
| Aluminum | More Negative than Negativee 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

#### 3.2.1 Excavation and Trenching

Perform trenching and backfilling in accordance with Section 31 00 00 EARTHWORK. In the areas of the anode beds, all trees and underbrush will be cleared and grubbed to the limits shown or indicated. In the event rock is encountered in providing the required depth for anodes, determine an alternate approved location and, if the depth is still not provided, submit an alternate plan to the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Alternate techniques and depths must be approved prior to implementation.

#### 3.2.2 Anode Excavation

a. Excavate hole to a minimum 3 inches larger than the packaged anode diameter, 6 feet deep.

#### 3.2.3 Lead Wire Trench

b. Excavate lead wire trench to 24 inches deep, 3 inches wide.

### 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. Anodes must be installed as indicated in a dry condition after any plastic

or waterproof protective covering has been completely removed from the water permeable, permanent container housing the anode metal. The anode connecting wire must not be used for lowering the anode into the hole. The annular space around the anode must be backfilled with fine earth in 6 inch layers and each layer must be hand tamped.

3.3.1.1 Single Anodes

Single anodes, spaced as shown, will be connected through a test station to the pipeline, allowing adequate slack in the connecting wire to compensate for movement during backfill operation.

3.3.1.2 Group of Anodes

Groups of anodes, in quantity and location shown, must be connected to an anode header cable. The anode header cable must make contact with the structure to be protected only through a test station. Anode lead connection to the anode header cable must be made by an approved crimp connector or exothermic weld and splice mold kit with appropriate potting compound.

3.4 INSTALLATION DETAILS

3.4.1 Anode Installation

Do not lift or support anode by the lead wire. Where applicable, remove manufacturer's plastic wrap/bag from the anode. Exercise care to preclude damaging the cloth bag and the lead wire insulation. Center the packaged anode in the hole with native soil in layers not exceeding 6 inches. Hand tamp each layer to remove voids taking care not to strike the anode lead wire. When the backfill is 6 inches above the top of the anode, pour at least ten gallons of water into the hole to saturate the anode backfill and surrounding soil. Anodes must not be backfilled prior to inspection and approval by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager.

3.4.2 Lead Wire Installation

Cover the lead wire trench bottom with a 3 inch layer of sand or stone free earth. Center wire on the backfill layer. Do not stretch or kink the conductor. Place backfill over wire in layers not exceedingsix inches deep. Compact each layer thoroughly. Do not place tree roots, wood scrap, vegetable matter and refuse in backfill. Place cable warning tape within 12 inches of finished grade, above cable and conduit.

3.4.2.1 Lead Wire Connections

Connect anode lead wire(s) to the test station terminal board(s). The coating must be completely cured before backfilling. Allow sufficient slack in the lead wire to compensate for movement during backfilling operation.

3.4.2.2 Field Drawing

Complete a field drawing of each anode installation showing location of anode, test station, depth of anode, color and size of anode lead wire and any other pertinent details. Submit copy with daily report to the government.

3.4.2.3 Metallic Underground Pipeline Connection

To facilitate periodic electrical measurements during the life of the sacrificial anode system and to reduce the output current of the anodes, if required, all anode lead wires must be connected to a test station and buried a minimum of 24 inches in depth. The cable must be No. 10 AWG, stranded copper, HMWPE insulated cable. The cable must make contact with the structure only through a test station. Resistance wire must be installed between the cable and the pipe cable, in the test station, to reduce the current output, if required. Anode connections, except in the test station, must be accomplished by exothermic welding, and must be insulated by means of at least three (3) layers of electrical tape; and all lead wire connections must be installed in a moisture-proof splice mold kit and filled with epoxy resin. Lead wire-to-structure connections must be accomplished by an exothermic welding process. All welds must be in accordance with the manufacturer's recommendations. A backfill shield filled with a pipeline mastic sealant and material compatible with the coating must be placed over the weld connection and be of such diameter as to cover the exposed metal adequately. Anodes must be installed at a minimum of 8 feet and a maximum of 10 feet from the structure to be protected.

Contractor must take proper safety precautions prior to and during welding to live pipelines . Contractor must notify the activity Fuel Office via the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager a minimum of three days before performing exothermic welding to live lines. Exothermic welding must be conducted with product flowing through the pipeline to eliminate vapor spaces within the pipe and to dissipate the heat on the pipe. Exothermic weld charges for connections to live lines must be limited to a maximum 15 gram charge to prevent burning through the pipe wall. Exothermic weld connections must be spaced a minimum of6 inches apart. In the event of an unsuccessful weld, the new weld location must be located a minimum of 6 inches from the unsuccessful weld and any other existing welds. Contractor must obtain the services of a certified safety professional to approve the contractor's exothermic welding safety procedures. Results of this consultation must be included in the Contractor's Daily Report.

3.4.3 Underground Pipe Joint Bonds

Underground pipe having other than welded or threaded coupling joints must be made electrically continuous by means of a bonding connection installed across the joint.

3.4.4 Anode Junction Boxes

Provide junction boxes and mark each of the wires terminating in each box.

3.4.5 Bonding Boxes

Provide structure bonding boxes in locations as indicated.

3.4.6 Test Stations and Permanent Reference Electrodes

Test stations will be of the type and location shown and will be curb box mounted. Provide buried isolation joints with test wire connections brought to a test station. Reference all test stations with GPS coordinates. Unless otherwise shown, locate other test stations and permanent reference electrodes as follows:

a. At all isolation joints.

b. At both ends of casings.

c. Where the pipe crosses any other metal pipes.

d. Where the pipe connects to an existing piping system.

e. Where the pipe connects to a dissimilar-metal pipe.

Do not fill the bottom of the test station with concrete unless otherwise specified. Do not place rubbish, scrap or other debris into the test station.

3.4.7 Permanent Reference Electrode Verification

Verify permanent reference electrodes against a calibrated portable electrode in the presence of the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager before installation. Verify in a non-metallic container of water. Permanent electrode must measure a reference potential agreeing with that measured by the portable electrode within plus or minus 0.010 volts when the sensing windows of the two electrodes being compared are not more than 1/6 inch apart but not touching. Remove permanent reference electrodes not within this potential range from the construction site by the end of the day and replace at the contractor's expense. The testing provision applies to replacement permanent reference electrodes as well.

3.4.7.1 Field Drawings

Complete a field drawing of each anode installation showing location of anode, depth of anode, color and size of anode lead wire and any other pertinent details test station location and diagram Underground Pipe Joint bond locations and details Anode Junction Box Location and details Permanent Reference Electrode locations Location of all Electrical Isolations. Submit copy with daily report to the government.

3.5 ELECTRICAL ISOLATION OF STRUCTURES

3.5.1 Isolation Fittings

Isolating fittings, including isolating flange kits, dielectric unions and couplings, must be installed aboveground, or within manholes, wherever possible. Where isolating joints must be covered with soil, they must be fitted with a proper joint cover specifically manufactured for covering the particular joint, and the space within the cover filled with hot coal-tar enamel or hot petrolatum wax. Isolating fittings in lines entering buildings must be located at least 12 inch above grade of floor level, when possible. Isolating joints must be provided with grounding cells to protect against over-voltage surges or approved surge protection devices. The cells must provide a low resistance across isolating joint without excessive loss of cathodic current.

3.5.2 Dielectric Unions

Cut pipe ends square, remove fins and burrs, cut taper pipe threads in accordance with ASME B1.20.1. Provide isolation unions as indicated. Work piping into place without springing or forcing. Apply joint compound

or thread tape to male threads only. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed. Cover unions with an electrically insulating coating.

3.5.3 Joint Bonds

Provide joint bonds on metallic pipe to and across buried flexible couplings, mechanical joints, flanged joints except at places where isolation joints are specified and joints not welded or threaded to provide electrical continuity. Connect bond wire(s) to the structure(s) by use of exothermic weld kit(s). Clean the structure surface by scraping, filing or wire brushing to produce a clean, bright surface. Weld connections using exothermic kits in accordance with the kit manufacturer's instructions. Check and verify adherence of the bond to the substrate for mechanical integrity by striking the weld with a 2 pound hammer. Cover connections with an electrically insulating coating which is compatible with the existing coating on the structure.

3.5.4 Casings, Isolation, and Seals

Where the pipeline is installed in a casing under a roadway or railway, isolate the pipeline from the casing, and seal the annular space against intrusion of water.

3.6 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.

3.6.1 Tests and Measurements

3.6.1.1 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. Base potential tests: At least one week after backfilling of the pipe and installation of the anodes, but before connection of anodes to the structure, measure base (native) structure-to-electrolyte potentials of the pipe. Perform measurements at anode junction boxes, test stations and other locations suitable for test purposes (such as service risers or valves. The locations of these measurements must be identical to the locations specified for potential measurements with anodes connected. Use the same measuring equipment that is specified for measuring protected potential measurements.

3.6.1.2 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 one week 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.

3.6.1.3 Isolation Testing

Before the anode system is connected to the pipe, an isolation test must be made at each isolating joint or fitting. This test will demonstrate that no metallic contact, or short circuit exists between the two isolated sections of the pipe. Any isolating fittings installed and found to be defective must be reported to the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager.

3.6.1.4 Isolation Tester

An Isolation Tester designed and manufactured for use in CP, using the continuity check circuit, must be used for all isolating joint (flange) electrical testing. Testing must conform to the manufacturer's operating instructions. Test must be witnessed by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. An isolating joint that is good will read full scale on the meter. If an isolating joint is shorted, the meter pointer will be deflected or near zero on the meter scale. Location of the fault will be determined from the instructions, and the joint must be repaired.

3.6.1.5 Anode Output

As the anodes or groups of anodes are connected to the pipe, current output will be measured with an approved clamp-on milliammeter, calibrated shunt with a suitable millivoltmeter or multimeter, or a low resistance ammeter. (Of the three methods, the low-resistance ammeter is the least desirable and most inaccurate. The clamp-on milliammeter is the most accurate.) The values obtained and the date, time, and location must be recorded.

3.6.1.6 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.

3.6.1.7 Casing Tests

Before final acceptance of the installation, the electrical isolation of carrier pipe from casings must be tested and any short circuits corrected.

3.6.1.8 Holiday Test

Any damage to the protective coating during transit and handling must be repaired before installation. After field-coating has been applied, the entire pipe must be inspected by an electric holiday detector with impressed current in accordance with NACE SP0188 using a full-ring, spring-type coil electrode. The holiday detector will be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Holidays in the protective coating must be repaired upon detection. Occasional checks of holiday detector potential will be made by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager to determine suitability of the detector. Labor, materials, and equipment necessary for conducting the inspection must be furnished by the contractor. The coating system must be inspected for holes, voids, cracks, and other damage during installation.

3.6.1.9 Stray Current Measurements

Before final acceptance of the installation, stray current tests must be performed on any foreign pipes in close proximity to the installed anodes. A full report of the tests giving all details must be made.

3.6.1.10 Induced AC Testing

Before final acceptance of the installation, induced AC Voltage tests must be performed on the pipes near high AC Voltage infrastructure and where crossing above ground and underground AC transmission systems. A full report of these tests must be included in the final testing reports with all details and data taken. The touch potential of any testing over 5 volts must be reported to the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Any touch potential over 10 Volts must be mitigated by effective mitigation techniques. Refer to NACE SP0177 and NACE SP21424.

3.6.1.11 Interference Tests

Before final acceptance of the installation, interference tests will be made with respect to any foreign pipes in cooperation with the owner of the foreign pipes. A full report of the tests giving all details must be made. Stray current measurements must be performed at all isolating locations and at locations where the new pipeline crosses foreign metallic pipes; results of stray current measurements must also be submitted for approval. The method of measurements and locations of measurements must be submitted for approval. As a minimum, stray current measurements must be performed at the following locations:

a. Connection points of new pipeline to existing pipeline.

b. Crossing points of new pipeline with other existing metallic pipelines.

3.6.1.12 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, anode outputs, 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.

3.6.1.13 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.

3.6.1.14 One-Year-Warranty-Period-Testing

The contractor must inspect, test, and adjust the cathodic protection system quarterly for one year, 4 interim inspections total, to ensure its continued conformance with the criteria outlined below. The performance period for these tests will commence upon the completion of all cathodic protection work, including changes required to correct deficiencies identified during initial testing, and preliminary acceptance of the cathodic protection system by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager. Copies of the One Year Warranty Period Cathodic Protection System Field Test Report, including field data, and certified by the contractor's corrosion engineer must be submitted to the Contracting Officer or Contracting Officer's Representative, the activity, and the geographic EFD corrosion engineer.

3.6.1.15 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.

## 3.7 CLOSEOUT ACTIVITIES

### 3.7.1 Reconditioning of Surfaces

#### 3.7.1.1 Concrete

Concrete must be 3000 psi minimum ultimate 28-day compressive strength with one inch minimum aggregate conforming to ASTM C94/C94M.

#### 3.7.1.2 Restoration of Sod

Restore unpaved surfaces disturbed during the installation of anodes and wires to their original elevation and condition. In areas where grass cover exists, it is possible that sod can be carefully removed, watered, and stored during construction operations, and replaced after the operations are completed since it is estimated that no section of pipeline must remain uncovered for more than two (2) days. Where the surface is disturbed in a newly seeded area, re-seed the area with the same quality and formula of seed as that used in the original seeding. Seeding must be done as directed, in all unsurfaced locations where sod and topsoil could not be preserved and replaced. The use of sod in lieu of seeding will require approval by the Contracting Officer or the Contracting Officer's Representative, Technical Expert and Project Manager.

#### 3.7.1.3 Restoration of Pavement

Repair pavement, sidewalks, curbs, and gutters where existing surfaces are removed or disturbed for construction. Saw cut pavement edges. Graded aggregate base course must have a maximum aggregate size of 1 1/2 inches. Prime base course with liquid asphalt, ASTM D2028/D2028M, Grade RC-70 prior to paving. Match base course thickness to existing but must not be less than 6 inches. Asphalt aggregate size must be 1/2 inch , asphalt cement must conform to ASTM D3381/D3381M, Grade AR-2000. Match asphalt concrete thickness to existing but must not be less than 2 inches. Repair Portland cement concrete pavement, sidewalks, curbs, and gutters using 3,000 psi concrete conforming to ASTM C94/C94M Match existing pavement, sidewalk, curb, and gutter thicknesses.

#### 3.7.1.4 Cleanup

The contractor is responsible for cleanup of the construction site. All paper bags, wire clippings, must be disposed of as directed. Paper bags, wire clippings and other waste will not be put in bell holes or anodes excavation.

3.7.2 Training

3.7.2.1 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 four 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.

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SECTION 26 51 00

INTERIOR LIGHTING
**05/20, CHG 2: 11/21**

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 A580/A580M | (2018) Standard Specification for Stainless Steel Wire |
| 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 B164 | (2003; R 2014) Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire |
| ASTM B633 | (2019) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel |
| 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 |

ILLUMINATING ENGINEERING SOCIETY (IES)

| | |
|---|---|
| ANSI/IES LM-79 | (2019) Approved Method: Electrical and Photometric Measurements of Solid State Lighting Products |
| ANSI/IES LM-80 | (2020) Approved Method: Measuring Luminous |

| | |
|---|---|
| | Flux and Color Maintenance of LED Packages, Arrays and Modules |
| ANSI/IES LS-1 | (2020) Lighting Science: Nomenclature and Definitions for Illuminating Engineering |
| ANSI/IES TM-15 | (2020) Technical Memorandum: Luminaire Classification System for Outdoor Luminaires |
| ANSI/IES TM-21 | (2021) Technical Memorandum: Projecting Long-TermLuminous, Photon, and Radiant Flux Maintenance of LED Light Sources |
| ANSI/IES TM-30 | (2020) Technical Memorandum: IES Method for Evaluating Light Source Color Rendition |
| IES Lighting Library | IES Lighting Library |

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 | (2020) 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 ICS 6 | (1993; R 2016) Industrial Control and Systems: Enclosures |
| 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 2020) Standard for General Color Requirements for Wiring Devices |
| NEMA WD 7 | (2011; R 2016; R 2021) Occupancy Motion Sensors Standard |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) 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 | (2018; Reprint Jan 2021) UL Standard for Safety General-Use Snap Switches |
| UL 94 | (2013; Reprint Apr 2022) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances |
| UL 508 | (2018; Reprint Jul 2021) UL Standard for Safety Industrial Control Equipment |
| UL 844 | (2012; Reprint Oct 2021) UL Standard for Safety Luminaires for Use in Hazardous (Classified) Locations |
| UL 916 | (2015; Reprint Oct 2021) UL Standard for Safety Energy Management Equipment |
| UL 917 | (2006; Reprint Aug 2013) UL Standard for Safety Clock-Operated Switches |
| 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 1598C | (2014) Standard for Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits |
| 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 2021) 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. Commissioning requirements for Army and Air Force projects are specified in Section 01 91 00.15 10 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 ANSI/IES LS-1.

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 ANSI/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-RO

Occupancy/Vacancy Sensor Coverage Layout

Lighting Control System One-Line Diagram

Sequence of Operation for Lighting Control System

SD-03 Product Data

Luminaires; G-RO

Light Sources

LED Drivers

Luminaire Warranty; G-RO

Lighting Controls Warranty; G-RO

Local Area Controller; G-RO

Lighting Relay Panel; G-RO

Gateway

Switches

Digital Switch Timers

Wall Box Dimmers

Scene Wallstations; G-RO

Occupancy/Vacancy Sensors

Photosensors

Time Clocks; G-RO

Power Packs

Exit Signs; G-RO

Emergency Drivers

SD-05 Design Data

Luminaire Design Data; G-RO

Photometric Plan; G-RO

SD-06 Test Reports

ANSI/IES LM-79 Test Report; G-RO

ANSI/IES LM-80 Test Report; G-RO

ANSI/IES TM-21 Test Report; G-RO

ANSI/IES TM-30 Test Report; G-RO

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 Lighting Library 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, zonal lumen data, and candlepower distribution data must accompany shop drawings.

1.5.2 Luminaire Design Data

a. Provide safety certification and file number for the luminaire family that must be listed, labeled, or identified in accordance with the NFPA 70. 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).

b. Provide long term lumen maintenance projections for each LED luminaire in accordance with ANSI/IES TM-21. Data used for projections must be obtained from testing in accordance with ANSI/IES LM-80.

1.5.3 ANSI/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 ANSI/IES LM-79.

1.5.4 ANSI/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 ANSI/IES LM-80.

1.5.5 ANSI/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 ANSI/IES TM-21.

1.5.6 ANSI/IES TM-30 Test Report

Submit color vector graphic in accordance with ANSI/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.

1.5.7 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.

1.5.8 Photometric Plan

1.5.8.1 Computer-generated Photometric Plans

Computer-generated photometric plans for each space are required to verify proposed luminaires and locations meet the required performance criteria of the design using the applicable light loss factor (LLF).

Target illumination levels are provided for each Interior Application. Depending on the application and the recommendations provided by the IES, values are given as one of the following:

a. Minimum: No values anywhere on the calculation grid may be less than this value, within a 10 percent margin of error.

b. Minimum Average: An average, taken over the entire task area for the application, may not be less than this value, within a 10 percent margin of error.

c. Maximum: No values anywhere on the calculation grid may be greater than this value, within a 10 percent margin of error.

d. Maximum Average: An average, taken over the entire task area for the application, may not be greater than this value, within a 10 percent margin of error.

e. Uniformity: Unless otherwise noted, uniformity is calculated as a ratio of the average calculated illuminance over the minimum calculated illuminance of the calculation grid.

1.5.8.2 Schematic Photometric Plan Calculations

Schematic photometric plan calculations must include:

a. Horizontal illuminance measurements at workplane or other designated height above finished floor, taken at a maximum of every one foot across the task area.

b. Average maintained illuminance level.

c. Minimum and maximum maintained illuminance levels.

d. Lighting power density (Watts per square foot).

e. LLF. Recommended LLF is 0.7 for LED luminaires but LLF varies based on environment and application.

1.5.8.3 Final Photometric Plan Calculations

Final photometric plan calculations must include:

a. Horizontal illuminance measurements at workplane or other designated height above finished floor, taken at a maximum of every one foot across the task area.

b. Where applicable, vertical illuminance measurements at designated surface, taken at a maximum of every one foot across task area.

c. Minimum and maximum maintained illuminance levels.

d. Average maintained illuminance level.

e. Average to minimum and maximum to minimum ratios for horizontal illuminance.

f. Lighting power density (Watts per square foot).

g. LLF. Recommended LLF is 0.81 for LED luminaires but LLF varies based on environment and application.

1.5.9 Occupancy/Vacancy Sensor Coverage Layout

Provide floor plans showing coverage layouts of all devices using manufacturer's product information.

1.5.10 Test Laboratories

Test laboratories for the ANSI/IES LM-79 and ANSI/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.

1.5.11 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.

1.5.12 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.

1.5.12.1 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.

1.5.12.2 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 15 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. 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, ANSI/IES LM-79, ANSI/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. ANSI/IES TM-21, ANSI/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, 2 by 4, and 2 by 2 | 100 LPW |
| Recessed Downlight (fixed, adjustable, wallwash) | 80 LPW |
| Linear, Ambient (indirect wall mount, linear pendent) | 100 LPW |
| High Bay, Low Bay, and Industrial Locations | 100 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. ANSI/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 |
| Exterior Wall Sconce | Below or at 4 feet AFF | B4-U0-G4 |
| Steplight | Above 4 feet AFF | B1-U1-G2 |
| Steplight | Below or at 4 feet AFF | B4-U1-G4 |
| Parking Garage Luminaire | Ceiling mounted | B4-U4-G3 |

2.2.1.1 Luminaire Conversion Kits

Provide luminaire conversion kits that meet UL 1598C Standard for Light-Emitting Diode (LED) Retrofit Luminaire Conversion Kits.

2.2.2 Luminaires for Hazardous Locations

In addition to requirements stated herein, provide LED luminaires for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

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

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 80.

c. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

d. 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 2 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. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

k. Provide dimming capability as indicated in the luminaire schedule on project plans. Dimmable drivers must dim down to 1 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. 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 120-277 volts at 50/60 hertz.

b. Indicated zones, with relays rated 20 amps with one manual switch or dimmer 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 capability for receptacle load control from occupancy sensors.

f. Provide full 'OFF' function with input from external time clock input.

g. Capable of 0-10V dimming.

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 Relay Panel

UL 924. 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 power supply as required.

b. 16 single-pole latching relays rated at 20 amps, 120-277 volts. Provide provision for relays to close upon power failure. Provide relays designed for 10 years of use at full rated load.

c. Relay control module operates at 24 VDC and is rated to control a minimum of 16 relays.

d. Capable of 0-10V dimming.

2.5.1.2.2 Gateway

Provide gateway in accordance with Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM. Provide hardware and software to enable the BAS to monitor, control, display, and record data for use in processing reports. Provide BACnet communication interface that enables remote control and monitoring of lighting from a workstation according to read access points and write access points listed in this section. Control features and monitoring points displayed locally at lighting panel must be available through the Gateway. Provide Gateway that meets the following requirements:

a. Microprocessor-based communications device that perform bi-directional protocol translation.

b. Support full bi-directional communication and translation.

c. Contain its own microprocessor, RAM, battery, communication ports, and power supply.

d. Support an additional 5 percent points for future expansion.

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 Digital Switch Timers

Provide line-voltage toggle switches that allow manual control to ON and automatically switches lighting load to OFF. Device operates with the use of paddle, button, or toggle, and operates at 120-277 volts. Device allows for programming of auto off timer from 5 minutes to 6 hours.

2.5.2.3 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 1 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.

2.5.2.4 Scene Wallstations

Provide scene wallstations that are compatible with the other components of the lighting control system and capable of Class 1 or 2 wiring methods in accordance with the NEC and local codes. Provide devices that contain on/off group, preset scene functions, or dim up/dim down interface through front panel. Programming of new scenes or zone assignments must be accomplished by authorized personnel from the space being controlled. Provide labeling for each button, including laminated sheet with scene descriptions to be posted near each scene controller.

2.5.2.5 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 manufacturer shop drawings. 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 12-24 volts.

b. Time delay of 30 seconds to 30 minutes with at least four intermediate time delay settings.

c. Sensors are ceiling mountedwall mounted.

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 with push-button or dip switch on the sensor device.

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.

2.5.2.5.1 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.

2.5.2.5.2 High Bay Sensors

Provide occupancy/vacancy sensors specifically designed for high-bay mounting applications for all ceiling-mounted sensors 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.

2.5.2.5.3 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.

2.5.2.6 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.

2.5.2.7 Time Clocks

UL 917, NEMA ICS 6. House time clock in a surface-mounted, lockable, NEMA 1 enclosure constructed of painted steel or plastic polymer. Provide electronic type time clock that meets the following criteria:

a. Astronomic7 day programming function, providing a total of 96 on/off set points.

b. 24 hour type digital clock display format.

c. Power outage back-up for time clock utilizing lithium battery which provides coverage for a minimum of four days.

d. Capable of controlling a minimum of 8 channels or loads.

e. Contacts are rated for 30 amps at 120-277 VAC resistive load in a SPST normally open (NO) configuration.

f. Contains function that allows automatic control to be skipped on certain selected days of the weekmanual bypass or remote override controldaylight savings time automatic adjustmentEEPROM memory module momentary function for output contactsability for photosensor input.

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 painted, die-cast aluminum.Edge-lit type with clear acrylic, edge-lit face and aluminum trim having clear aluminum finish.

b. UL listed for damp 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. Provide self-diagnostic circuitry integral to emergency LED driver. In lieu of battery, can use a

nonradioactive photoluminescent plate.

2.6.2 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. Integral nickel-cadmium battery is required to supply a minimum of 90 minutes of emergency power, constant output. Driver must be RoHS compliant, rated for installation in plenum-rated spaces and damp locations, and be warranted for a minimum of five years.

2.6.3 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 pendents 4 feet or longer to limit swinging.

c. Single-unit suspended luminaires must have twin-stem 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 pendent 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.

2.7.3.4 Straps

Galvanized steel, one by 3/16 inch, 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.

2.8 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 _____":

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 pendents 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

aint 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

3.1.5.1 Scene Wallstations

Submit labeling templates for all scene wallstations, ganged faceplates and other manual control cover plates. Label each scene control button with approved scene description.

3.1.5.2 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.

3.1.5.3 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 10 TOTAL BUILDING COMMISSIONING. 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 --

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SECTION 26 56 00

EXTERIOR LIGHTING
**08/21**

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 B117 | (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus |

EUROPEAN UNION (EU)

| | |
|---|---|
| Directive 2011/65/EU | (2011) Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment |

ILLUMINATING ENGINEERING SOCIETY (IES)

| | |
|---|---|
| ANSI/IES LM-79 | (2019) Approved Method: Electrical and Photometric Measurements of Solid State Lighting Products |
| ANSI/IES LM-80 | (2020) Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules |
| ANSI/IES LS-1 | (2020) Lighting Science: Nomenclature and Definitions for Illuminating Engineering |
| ANSI/IES RP-8 | (2018; Addenda 1 2020; Errata 1-2 2021) Recommended Practice for Design and Maintenance of Roadway and Parking Facility Lighting |
| ANSI/IES TM-15 | (2020) Technical Memorandum: Luminaire Classification System for Outdoor Luminaires |
| ANSI/IES TM-21 | (2021) Technical Memorandum: Projecting Long-TermLuminous, Photon, and Radiant Flux Maintenance of LED Light Sources |
| IES Lighting Library | IES Lighting Library |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| IEEE 100 | (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms |

| | |
|---|---|
| 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 | (2020) 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 |
| NEMA WD 7 | (2011; R 2016; R 2021) Occupancy Motion Sensors Standard |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |

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; Reprint Jun 2022) UL Standard for Safety Class 2 Power Units |
| UL 1598 | (2021; Reprint Jun 2021) Luminaires |
| UL 8750 | (2015; Reprint Sep 2021) 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(s) 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. Commissioning

requirements for Army and Air Force projects are specified in Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING. C

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 ANSI/IES LS-1.

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 ANSI/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

Luminaire Drawings; G-RO

Control System One-Line Diagram; G-RO

Sequence of Operation for Exterior Lighting Control System

SD-03 Product Data

Luminaires; G-RO

Light Sources

LED Drivers

Luminaire Warranty; G-RO

Lighting Controls Warranty; G-RO

Motion Sensors

Photosensors

Obstruction Marker Luminaires; G-RO

SD-05 Design Data

Luminaire Design Data; G-RO

SD-06 Test Reports

ANSI/IES LM-79 Test Report

ANSI/IES LM-80 Test Report

ANSI/IES TM-21 Test Report

SD-10 Operation and Maintenance Data

Lighting System, Data Package 5

Exterior 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 Lighting Library as applicable, for the lighting system specified.

### 1.5.1 Drawing Requirements

#### 1.5.1.1 Luminaire Drawings

Include dimensions, 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.

### 1.5.2 Luminaire Design Data

a. Provide distribution data according to IES classification type as defined in IES Lighting Library and ANSI/IES RP-8.

b. B.U.G. rating for the installed position as defined by ANSI/IES TM-15 and shielding as defined by ANSI/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 ANSI/IES TM-21. Data used for projections must be obtained from testing in accordance with ANSI/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 ANSI/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 ANSI/IES LM-79.

1.5.4 ANSI/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 ANSI/IES LM-80.

1.5.5 ANSI/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 ANSI/IES TM-21.

1.5.6 Test Laboratories

Test laboratories for the ANSI/IES LM-79 and ANSI/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.

1.5.7 Regulatory Requirements

Equipment, materials, installation, and workmanship must be in accordance with the mandatory 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.

1.5.8 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.

1.5.8.1 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.

1.5.8.2 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 15 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.

1.6.2 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 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 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. 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 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.

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, ANSI/IES LM-79, ANSI/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. ANSI/IES TM-21, ANSI/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) | 119 LPW |
| Pedestrian Post-Top (pole mounted, arm mounted) | 97 LPW |
| Bollard | 45 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 Lighting Library. 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. ANSI/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 |
|---|---|---|
| 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.

2.2.2 Obstruction Marker Luminaires

Provide obstruction marker luminaires for facilities as required by the FAA.

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 80.

c. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

d. 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 120-277 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.

j. Directive 2011/65/EU. Restriction of Hazardous Substances (RoHS) compliant.

k. UL listed for wet locations typical of exterior installations.

l. Dimmable, and compatible with a standard dimming control circuit of 0 - 10V.

m. Rated to operate between ambient temperatures of minus 22 degrees F and 122 degrees F.

## 2.5 LIGHTING CONTROLS

Provide network certification for all networked lighting control systems and devices.

### 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, cadmium sulfide light sensor type, rated at 1920 watts, 120 volts, 50/60 Hz with single-pole, double-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 polycarbonate, 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. Directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition.

g. 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.

h. Provide photosensors with metal oxide varistor (MOV) type surge protection.

2.5.2.2 Motion Sensors

NEMA WD 7, UL 773A. Provide sensors that meet the following requirements:

a. Operating voltage of 120-277 volts.

b. Passive infrared type sensors with 270 degree coverage.

c. Time delay that can be adjusted from 15 seconds to 15 minutes.

d. Default state is "Fail to ON position."

e. Sensors installed integral to the luminaire must be provided by the luminaire manufacturer.

f. Sensor contains an integral light level sensor that does not allow luminaires to operate during daylight hours

g. Mounted directly to luminaire.

h. Operates in conjunction with bi-level controllers that reduce the connected lighting power by 50 percent.

## 2.6 EQUIPMENT IDENTIFICATION

### 2.6.1 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.

### 2.6.2 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.

## 2.7 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

### 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 LED Drivers

Provide LED drivers integral to luminaire as constructed by the manufacturer.

### 3.1.3 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.

### 3.1.4 Lighting Controls

#### 3.1.4.1 Photosensors

Aim photosensor according to manufacturer's recommendations.

3.1.4.2 Motion Sensors

Locate sensors in accordance with the manufacturer's recommendation. Locate sensors to achieve coverage of areas as indicated on project plans. Coverage patterns must be derated as recommended by manufacturer based on mounting height of sensor and any obstructions such as trees. Do not use gross rated coverage in manufacturer's product literature.

3.1.5 Grounding

Ground noncurrent-carrying parts of equipment including 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.

3.3 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.

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CABLE TRAYS FOR COMMUNICATIONS SYSTEMS

**05/17**

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CABLE TRAYS FOR COMMUNICATIONS SYSTEMS
**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.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| 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 |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA VE 1 | (2017) Metal Cable Tray Systems |
| NEMA VE 2 | (2018; ERTA 1-2 2018) Cable Tray Installation Guidelines |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |

1.2 ADMINISTRATIVE REQUIREMENTS

1.2.1 Pre-Installation Meetings

The Contracting Officer will schedule a pre-installation meeting within 30 days of contract award. Submit fabrication drawings for review and approval.

Submit manufacturer's product data for the following items:

a. Cable Trays

b. Supports

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-RO

Installation Drawings; G-RO

SD-03 Product Data

Cable Trays; G-RO

Supports; G-RO

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

1.4 QUALITY CONTROL

Comply with NEMA VE 1.

Comply with NEC, requirements that apply to the construction and installation of cable tray and cable channel systems (Article 392 NEC).

Provide products that are UL-classified and labeled with the UL classification mark.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide ladder cable trays consisting of two longitudinal side members connected by individual transverse members.

2.2 FABRICATION

Submit fabrication drawings for cable trays. Ensure the drawings contain details showing the fabrication and assembly details performed in the factory.

Before assembly, use an antioxidant compound to coat the contact surfaces of trays. Ensure that the finishes of edges, fittings, and hardware are free from burrs and sharp edges. Include splice and end plates, dropouts, and miscellaneous hardware.

2.3 COMPONENTS

2.3.1 Supports

Permit both vertical and horizontal adjustment, where possible on supports and hangers. Provide an adequate bearing surface for the tray on the horizontal and vertical tray supports, and ensure that the surface can accommodate holddown clamps or fasteners. Provide a means, other than friction, for securely fastening cable trays to supports.

Provide support for cable trays at intervals of no more than 6 -foot. Place supports for horizontal-elbow tray fittings within 2 -feet of each fitting extremity and as recommended by the cable tray manufacturer.

Ensure that the cable trays can carry at least 150 pounds per linear foot when supported at 6 -foot intervals. Ensure that the tray fittings have a load-carrying capacity that is equal to or greater than that of straight tray sections. Ensure that the radius of tray fittings is based on the

minimum bending radius of the cables, as specified by the cable manufacturer.

## 2.4 MATERIALS

Provide cable trays constructed of steel in accordance with ASTM A1008/A1008M and that has a zinc coating which was applied after fabrication.

# PART 3 EXECUTION

Comply with NEMA VE 2 for cable tray installation.

## 3.1 INSTALLATION

### 3.1.1 Manufacturer's Instructions

Submit the manufacturer's instructions for cable trays, including special provisions required to install equipment components and system packages. Ensure that the instructions specify impedances, hazards and safety precautions.

### 3.1.2 Installation Drawings

No later than 30 calendar days before shipment, submit installation drawings to the Contracting Officer for approval. Coordinate drawings with those being used for all other work in the immediate area to ensure that this other work does not conflict with the installation. Include the layout of the cable tray work and details on both horizontal and vertical supports as specified in the paragraph SUPPORTS.

### 3.1.3 Grounding

Provide properly grounded cable trays by means that has a low-resistance conductor of sufficient capacity, and that is no smaller than No. 3/0 AWG aluminum. Bond the grounding conductor to cable tray sections and fittings by compatible bolted connections. Consider cable tray sections in tandem assembly as having electrical continuity when these sections are bonded with appropriate high-strength bolts. Provide permanent and continuous effective grounding with an impedance that is low enough to limit the potential above ground and to facilitate operation of overcurrent devices in the circuit. Provide grounding and bonding for cable trays in accordance with NFPA 70.

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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.

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 | (2021) Indoor Optical Cable |
| ICEA S-90-661 | (2021) Category 3 and 5E Individually Unshielded Twisted Pairs, Indoor Cables (With or Without an Overall Shield) for Use in General Purpose and LAN Communications Wiring Systems |

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; TIA 22-1; ERTA 1 2022) 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; R 2022) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 edition 2: Fibre-Optic Communications Subsystem Test Procedures - Part 4-2: Installed Cable Plant - Single-Mode Attenuation and Optical Return Loss Measurement |
| TIA-526-14 | (2015c) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant |
| TIA-568.0 | (2020e) Generic Telecommunications Cabling for Customer Premises |
| TIA-568.1 | (2020e) Commercial Building Telecommunications Infrastructure Standard |
| TIA-568.2 | (2018d) Balanced Twisted-Pair Telecommunications Cabling and Components Standards |
| TIA-568.3 | (2016d; Add 1 2019) Optical Fiber Cabling Components Standard |
| TIA-569 | (2019e) Telecommunications Pathways and Spaces |
| TIA-606 | (2021d) Administration Standard for Telecommunications Infrastructure |
| TIA-607 | (2019d) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises |
| TIA-1152 | (2016; R 2021) 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-604-10 | (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) |

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 50 | (2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations |

| | |
|---|---|
| UL 444 | (2017; Reprint Jun 2021) UL Standard for Safety Communications Cables |
| UL 467 | (2022) UL Standard for Safety Grounding and Bonding Equipment |
| UL 514C | (2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers |
| UL 723 | (2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials |
| UL 969 | (2017; Reprint Mar 2018) UL Standard for Safety Marking and Labeling Systems |
| UL 1286 | (2008; Reprint Apr 2021) UL Standard for Safety Office Furnishings |
| UL 1666 | (2007; Reprint Sep 2021) UL Standard for Safety 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 applies 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, TIA-568.2, TIA-568.3, 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 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. 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-RO

Telecommunications Space Drawings; G-RO

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-RO

Patch Panels; G-RO

Telecommunications Outlet/Connector Assemblies; G-RO

Equipment Support Frame; G-RO

Connector Blocks; G-RO

Spare Parts; G-RO

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-RO

SD-07 Certificates

Telecommunications Contractor Qualifications; G-RO

Key Personnel Qualifications; G-RO

Manufacturer Qualifications; G-RO

Test Plan; G-RO

SD-09 Manufacturer's Field Reports

Factory Reel Tests; G-RO

SD-10 Operation and Maintenance Data

Telecommunications Cabling and Pathway System Data Package 5; G-RO

SD-11 Closeout Submittals

Record Documentation; G-RO

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, except as specified otherwise. 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. Provide a plastic laminated schematic of the as-installed telecommunications cable system showing cabling, CD's, BD's, FD's, and the EF and ER for telecommunications keyed to floor plans by room number. Mount the laminated schematic in the EF telecommunications space as directed by the Contracting Officer. 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 backboard. 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, TIA-568.2 and TIA-568.3.

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 on electronic media using Windows based computer cable management software. A licensed copy of the cable management software including documentation, shall be provided. 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 only the required data fields 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 as a minimum in accordance with TIA-606.

1.10.3 Spare Parts

In addition to the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, provide a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

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, TIA-568.1, TIA-568.2, TIA-568.3 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, 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 tight buffered fiber optic multimode, 50/125-um diameter laser optimized(OM4) cable as indicated.

Provide plenum (OFNP), riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, 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.

Provide plenum (OFNP) riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, 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.

#### 2.3.2.1 Horizontal Copper

Provide horizontal copper cable, UTP, 100 ohm in accordance with TIA-568.2, UL 444, ANSI/NEMA WC 66, ICEA S-90-661 . Provide four each individually twisted pair, minimum size 24 AWG conductors, Shielded Category 6A, with a blue 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), riser (CMR), or general purpose (CM or CMG) 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. Provide Shielded CAT6A blue cable for phone outlets only. All other horizontal cable will be OM4 MMF.

2.3.2.2 Horizontal Optical Fiber

Provide optical fiber horizontal cable in accordance with ICEA S-83-596and TIA-568.3. Cable shall be tight buffered, multimode, 50/125-um diameter laser optimized, OM4, multimode, 50/125-um diameter. Cable shall be imprinted with manufacturer, flammability rating and fiber count at regular intervals not to exceed 40 inches.

Provide plenum (OFNP), riser (OFNR), or general purpose (OFN or OFNG) rated non-conductive, fiber optic cable 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 be UL listed and labeled for wet locations in accordance with NFPA 70. The cable jacket shall be of single jacket construction with color coding of cordage jacket, fiber, unit, and group in accordance with the color of the classification of the cable (NIPR/SIPR/PROGRAM - Green/Red/Orange).

2.3.3 Work Area Cabling

2.3.3.1 Work Area Copper

Provide work area copper cable in accordance with TIA-568.2, with a blue CAT6A thermoplastic jacket.

2.3.3.2 Work Area Optical Fiber

Provide optical work area cable in accordance with TIA-568.3.

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. Backboards shall be fire rated by manufacturing process. Fire stamp shall be clearly visible. Paint applied over fire retardant backboard shall be UL 723 fire retardant paint. Provide label including paint manufacturer, date painted, UL listing and name of Installer. When painted, paint label and 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. Bracket, wall mounted, 8 gauge aluminum. Provide hinged bracket compatible with 19 inches panel mounting.

b. Cabinets, freestanding modular type, 16 gauge steel construction, minimum, treated 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 Lockable cabinet with grounding bar, roof mounted 550 CFM fan with filter and a surge protected power strip with 6 duplex 20 amp receptacles. All cabinets shall be keyed alike.

c. Cabinets, Lockable wall-mounted modular type, 16 gauge steel construction, minimum, treated to resist corrosion. Cabinet shall have have lockable front doors, louvered side panels, 250 CFM roof mounted fan, ground lug, and top and bottom cable access. Cabinet shall be compatible with 19 inches panel mounting. All cabinets shall be keyed alike. A surge protected power strip with 6 duplex 20 amp receptacles shall be provided within the cabinet.

2.4.3 Connector Blocks

Provide insulation displacement connector (IDC) Type 110 for Shielded CAT6A 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 19 inches equipment cabinets and telecommunications backboards. Cable guides of ring or bracket type devices mounted on cabinet panels backboard for horizontal cable management and individually mounted for vertical cable management. Mount cable guides with screws, and or nuts and lockwashers.

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 and copper patch cords for patch panels. 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. Patch cords shall meet minimum performance requirements specified in TIA-568.1, TIA-568.2 and TIA-568.3 for cables, cable length and hardware specified.

2.4.5.1 Modular to 110 Block Patch Panel

Provide in accordance with TIA-568.1 and TIA-568.2. Panels shall be third party verified and shall comply with EIA/TIA Shielded CAT6A requirements. Panel shall be constructed of 0.09 inches minimum aluminum and shall be cabinet rack wall mounted and compatible with an ECIA EIA/ECA 310-E 19 inches equipment cabinet. 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.

2.4.5.2 Fiber Optic Patch Panel

Provide panel for maintenance and cross-connecting of optical fiber cables. Panel shall be constructed of 16 gauge steel minimum and shall be cabinet mounted and compatible with a ECIA EIA/ECA 310-E 19 inches equipment rack. Each panel shall provide 12 multimode adapters as duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment

sleeves. Provide dust cover for unused adapters. The rear of each panel shall have a cable management tray a minimum of 8 inches deep with removable cover, incoming cable strain-relief and routing guides. Panels shall have each adapter factory numbered and be equipped with laminated plastic nameplates above each adapter.

2.4.6 Optical Fiber Distribution Panel

Cabinet mounted optical fiber distribution panel (OFDP) shall be constructed in accordance with ECIA EIA/ECA 310-E utilizing 16 gauge steel minimum. Panel shall be divided into two sections, distribution and user. Distribution section shall have strain relief, routing guides, splice tray and shall be lockable, user section shall have a cover for patch cord protection. Each panel shall provide 12 multimode pigtails and adapters. Provide adapters as duplex LC with zirconia ceramic. Provide dust covers for adapters. Provide patch cords as specified in the paragraph PATCH PANELS.

2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES

2.5.1 Outlet/Connector Copper

Outlet/connectors shall comply with FCC Part 68, TIA-568.1, and TIA-568.2. 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 Shielded CAT6A requirements. Outlet/connectors provided for UTP 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 for 200 mating cycles. UTP outlet/connectors installed in outdoor or marine environments shall be jell-filled type containing an anti-corrosive, memory retaining compound.

2.5.2 Optical Fiber Adapters(Couplers)

Provide optical fiber adapters suitable for 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 duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves. The connectors shall provide a maximum attenuation of 0.3 dB at 850, 1300, 1310 and 1550 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, TIA-568.2, TIA-568.3; flush or oversized design constructed of high impact thermoplastic material in color to match color of receptacle/switch cover plates specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM 302 stainless material. Provide labeling in accordance with the paragraph LABELING in this section.

## 2.6 MULTI-USER TELECOMMUNICATIONS OUTLET ASSEMBLY (MUTOA)

Provide MUTOA(s) in accordance with TIA-568.1.

## 2.7 TERMINAL CABINETS

Construct of zinc-coated sheet steel, 36 by 24 by 6 inches deep as indicated. Trim shall be fitted with hinged door and locking latch. Doors shall be maximum size openings to box interiors. Boxes shall be provided with 5/8 inch backboard with two-coat varnish finish. Match trim, hardware, doors, and finishes with panelboards. Provide label and identification systems for telecommunications wiring and components consistent with TIA-606.

## 2.8 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.

## 2.9 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00 FIRESTOPPING.

## 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

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.

## 2.12 TESTS, INSPECTIONS, AND VERIFICATIONS

### 2.12.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-568.1, TIA-568.2, TIA-568.3, TIA-526-7 for single mode optical fiber, and TIA-526-14 for multimode optical fiber cables.

# 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, TIA-568.2, TIA-568.3, 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.

3.1.1 Cabling

Install UTP, and optical fiber telecommunications cabling system as detailed in TIA-568.1, TIA-568.2, TIA-568.3. 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 Open Cable

Cable entering office areas from basket tray must be visible. Provide corrugated surface raceway that allows cable to be seen from the point of entrance, to the cubicle area above the cubicle entrance port. Install in accordance with TIA-568.1, TIA-568.2 and TIA-568.3. Do not exceed cable pull tensions recommended by the manufacturer. Copper cable not in a wireway or pathway shall be suspended a minimum of 8 inches above ceilings by cable supports no greater than 60 inches apart. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 inches shall be maintained when such placement cannot be avoided.

Plenum cable shall be used where open cables are routed through plenum areas. Cable routed exposed under raised floors shall be plenum rated. Plenum cables shall comply with flammability plenum requirements of NFPA 70. Install cabling after the flooring system has been installed in raised floor areas. Cable 6 feet long shall be neatly coiled not less than 12 inches in diameter below each feed point in raised floor areas.

3.1.1.2 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.

3.1.1.3 Horizontal Cabling

Install horizontal cabling as indicated on drawings Do not untwist Shielded CAT6A 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 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.

3.1.4 Work Area Outlets

3.1.4.1 Terminations

Terminate UTP cable in accordance with TIA-568.1, TIA-568.2 and wiring configuration as specified. Terminate fiber optic cables in accordance with TIA-568.3.

3.1.4.2 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.

3.1.4.3 Cables

Shielded CAT6A 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.

3.1.4.4 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.5 Telecommunications Space Termination

Install termination hardware required for Shielded CAT6A and optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.5.1 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.

3.1.5.2 Patch Panels

Patch panels shall be mounted in equipment cabinets 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 as recommended by the manufacturer 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.

3.1.5.3 Equipment Support Frames

Install in accordance with TIA-569:

a. Cabinets, freestanding modular type. When cabinets are connected together, remove adjoining side panels for cable routing between cabinets. Mount rack mounted fan in roof of cabinet.

3.1.6 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 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, TIA-568.2, TIA-568.3. 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 Shielded CAT6A 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, TIA-568.2, TIA-568.3. Visually confirm Category 6A, marking of outlets, cover plates, outlet/connectors, and patch panels.

3.5.1.2 Verification Tests

For multimode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568.3 and TIA-526-14 using Method A, Optical Power Meter and Light Source for multimode optical fiber. For single-mode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568.3 and TIA-526-7 using Method A, Optical Power Meter and Light Source for single-mode optical fiber. Perform verification acceptance tests.

3.5.1.3 Performance Tests

Perform testing for each outlet and MUTOA as follows:

a. Perform Shielded CAT6A link tests in accordance with TIA-568.1 and TIA-568.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.

b. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568.3.

3.5.1.4 Final Verification Tests

Perform verification tests for Shielded CAT6A 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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COMMUNICATIONS OPTICAL BACKBONE CABLING
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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.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM C338 | (1993; R 2013) Standard Test Method Softening Point of Glass |
| ASTM D4976 | (2012a) Standard Specification for Polyethylene Plastics Molding and Extrusion Materials |

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

| | |
|---|---|
| TIA/EIA 455-41-A | (1993a; R 2001) FOTP-41 - Compressive Loading Resistance of Fiber Optic Cables |

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

| | |
|---|---|
| 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 |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2020) Enclosures for Electrical Equipment (1000 Volts Maximum) |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

| | |
|---|---|
| NFPA 70 | (2020; TIA 22-1; ERTA 1 2022) National Electrical Code |

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

| | |
|---|---|
| SAE AMS-STD-595A | (2017) Colors used in Government Procurement |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA-455-33 | (2005b; R 2013) Optical Cable Tensile Loading and Bending Test |

| | |
|---|---|
| TIA-455-78-B | (2020c) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation |
| TIA-455-104 | (2016b) Standard for FOTP-104 Fiber Optic Cable Cyclic Flexing Test |
| TIA-455-177 | (2020c) FOTP-177 IEC-60793-1-43: Measurement Methods and Test Procedures - Numerical Aperture |
| TIA-472D000 | (2007b) Fiber Optic Communications Cable for Outside Plant Use |
| TIA-526-7 | (2015a; R 2022) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant, Adoption of IEC 61280-4-2 edition 2: Fibre-Optic Communications Subsystem Test Procedures - Part 4-2: Installed Cable Plant - Single-Mode Attenuation and Optical Return Loss Measurement |
| TIA-526-14 | (2015c) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant |
| TIA-568.1 | (2020e) Commercial Building Telecommunications Infrastructure Standard |
| TIA-568.3 | (2016d; Add 1 2019) Optical Fiber Cabling Components Standard |
| TIA-569 | (2019e) Telecommunications Pathways and Spaces |
| TIA-590 | (1997a) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant |
| 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-455-25 | (2016d) FOTP-25 Impact Testing of Optical Fiber Cables |
| TIA/EIA-598 | (2014D; Add 2 2018) Optical Fiber Cable Color Coding |
| TIA/EIA-604-3 | (2004b; R 2014) Fiber Optic Connector Intermateability Standard (FOCIS), Type SC and SC-APC, FOCIS-3 |
| TIA/EIA-4750000-C | (1996) Generic Specifications for Fiber Optic Connectors (ANSI) |

U.S. DEPARTMENT OF AGRICULTURE (USDA)

| | |
|---|---|
| RUS Bull 1753F-601 | (1994) Specifications for Filled Fiber Optic Cables (PE-90) |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| MIL-STD-188-176 | (1996; Notice 1) Standardized Profile for Asynchronous Transfer Mode (ATM) |

1.2 DEFINITIONS

References in this section to cable refer to fiber optic ("FO") cable. Fiber optic cable consists of optical fibers, strength members, and jacketing. Associated components include optical fiber connectors, optical patch panels, terminal bay cabinets, and splice closures as indicated.

1.3 ADMINISTRATIVE REQUIREMENTS

1.3.1 Pre-Installation Meetings

Within 30 calendar days after date of award, submit for the approval of the Contracting Officer six (6) copies of outline drawings of all equipment to be furnished under this contract, together with pre-construction and installation drawings and documents. Ensure drawings show the general arrangement and overall dimensions of the cable installation, control centers, space requirements, details of any hidden floor supports or ceiling systems and provisions for conduits for external cables. Submit the following for review and approval:

a. Fiber Optic System Contract Drawings

b. Detailed Shop Drawings

c. Qualifications

d. Quality Assurance Plan

Submit a quality assurance plan for fiber optic cable systems consisting of detailed procedures defining methods to ensure compliance to contract drawings and specifications by drawing control, inspection and procurement records, and test plan showing when and how each system will be tested, material testing, and certification records. Submit test plan to the Technical Representative for approval at least 30 calendar days prior to the start of testing.

Submit manufacturer's product data for the following items. Ensure data includes a complete list of parts, special tools, and supplies with current unit prices and source of supply:.

a. Optical Fibers

b. Fiber Optic Cable Design

c. Splice Organizers

d. Pre-Connected Cable Assembly

e. Fiber Optic Terminal Cabinets

f. Optical Patch Panel Assemblies

g. Fiber Optic Media Types

h. Fiber Optic Terminations and Connectors

i. Fiber Optic Enclosures

j. Fiber Optic Cable Installer and Splicer Qualifications

k. Manufacturer's Qualifications

l. Fiber Optic System Instructions

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

Qualifications; G-RO

Quality Assurance Plan; G-RO

SD-02 Shop Drawings

Fiber Optic System Contract Drawings; G-RO

Detailed Shop Drawings; G-RO

Record (As-Built) Drawings; G-RO

SD-03 Product Data

Optical Fibers; G-RO

Fiber Optic Cable Design; G-RO

Splice Organizers; G-RO

Pre-Connected Cable Assembly; G-RO

Fiber Optic Terminal Cabinets; G-RO

Optical Patch Panel Assemblies; G-RO

Fiber Optic Media Types; G-RO

Fiber Optic Terminations and Connectors; G-RO

Fiber Optic Enclosures; G-RO

SD-06 Test Reports

Factory Test Certificates; G-RO

Single and Multi-Mode OTDR Test; G-RO

End-to-End Attenuation Tests; G-RO

End-to-End Bandwidth Tests; G-RO

Fiber Optic Factory Test Plan; G-RO

Fiber Optic Field Tests Plan; G-RO

SD-07 Certificates

Fiber Optic Cable Installer and Splicer Qualifications; G-RO

Manufacturer's Qualifications; G-RO

SD-08 Manufacturer's Instructions

Fiber Optic System Instructions; G-RO

## 1.5 QUALITY CONTROL

### 1.5.1 Fiber Optic Cable Installer and Splicer Qualifications

Provide technicians installing FO media, splices and performing system tests who are certified and trained in accordance with an approved manufacturers training program, with a minimum of 3 years FO experience in installing equivalent FO systems. Submit data for approval to the Contracting Officer. Submit FO technician qualifications for approval 30 days before splices are to be made on the cable. Certification includes the training, and experience of the individual on specific type and classification of FO media to be provided under this contract.

Contracting officer may require each person who is to perform fiber optic cable splicing to perform a minimum of one acceptable sample splice and termination. Do not incorporate sample splices and terminations in the job.

### 1.5.2 Quality Assurance Plan

Prepare a quality assurance plan which provides a detailed outline of all testing to be accomplished, addresses whether cladding modes have been stripped prior to testing, source wavelength (peak), spectral width full width/half maximum (FWHM), mode structure, fiber end preparation, and bandwidth measurements of fiber links both greater and less than 1 kilometer. Quality assurance plan includes, as a minimum, a schedule of when tests will be performed relative to installation milestones, specific test procedure that will be used, a list of test equipment that will be used including manufacturer, model number, range, resolution accuracy and conformance to the specified requirements.

### 1.5.3 Manufacturer's Qualifications

Ensure FO media manufacturer has a minimum of 3 years experience in the manufacturing, assembly, and factory testing of FO media which comply with RUS Bull 1753F-601. Ensure manufacturer provides a list of customers with 3 years of maintenance logs documenting experience with government

customers.

1.5.4 Fiber Optic Factory Test Plan

Prepare and provide to the Government for review a test plan for factory and field tests of the FO media. Provide factory Optical Time Domain Reflectometer(OTDR) test data as part of the test report. Provide a list of factory test equipment. Include a FO link performance test plan. Submit the plan at least 30 days prior to tests for government approval. Refer to TIA-569 for performance measurement criteria. Conduct tests at all operating bandwidths. Provide calculations for optical power budget and bandwidth as required by RUS Bull 1753F-601 using test method TIA-455-78-B or TIA/EIA-455. Submit test plans and reports to the Government for review and approval.

1.5.5 Fiber Optic Field Tests Plan

Prepare and provide technicians and test equipment for field tests of FO media. Conduct OTDR reel tests at the job site prior to installation. Perform OTDR and end to end tests of all installed media. Conduct tests on single mode fiber in accordance with TIA-526-7 for single mode fiber and EIA TIA/EIA-526-14A for multi mode fiber.

1.6 DELIVERY, STORAGE, AND HANDLING

Ship media to job site on factory reels in 1000-ft lengths or in factory cartons. Provide a reel drum radius no smaller than the minimum bend radius recommended by the manufacturer for the media. Wind cable on the reel so that unwinding can be done without kinking the cable. Provide 6 1/2-feet pigtails of cable at each end of the reel readily accessible for testing. Attach a permanent label on each reel showing length, media, identification number, and date of manufacture. Provide water resistant label and ink on the labels. Apply end seals to each end of the media after testing and before terminating to prevent moisture from entering the cable while stored at the job site. Ensure reels are suitable for outside storage conditions when temperature ranges from minus 40 degrees F to plus 150 degrees F, with relative humidity from zero to 100 percent. Store equipment, other than FO media, delivered and placed in storage with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants.

1.7 PROJECT/SITE CONDITIONS

Ensure that the buried cable is fed through the plow into the ground at zero tension. Do not allow tension to develop in the cable.

Whenever the plow is stopped, unreel sufficient cable to guard against sudden jerks when the plow is started.

Exercise caution to ensure that the plow is not backed up while the blade is in the ground. Cable can be severely damaged by the plow backing up even a slight amount. During the plowing operation, the plow may strike a buried object or rock that would stop the equipment and necessitate removal of the plow from the ground. When this occurs, remove the plow carefully without backing up. When it is necessary to back the plow, uncover the cable a sufficient distance back from the plow for inspection by the Contracting Officer to determine if there is any damage. Immediately report any damage to the Contracting Officer. Repair or replace damages as directed by the Contracting Officer.

## PART 2 PRODUCTS

### 2.1 SYSTEM DESCRIPTION

Provide fiber optic cables for the duct in the existing cable duct and manhole system and/or directly buried to the facility. Provide modifications as design located within the fiber optic terminal in existing facility buildings.

Provide installation methods and procedures for installing the FO media and pathway system. Include methods and procedures for installing FO media, pathway, splices, and associated hardware. Submit installation procedures and equipment list to the Contracting Officer.

Provide detailed drawings for the fiber optic cable and pathway system. Provide single line schematic details of the fiber optic and pathway media, splices, and associated construction materials. Ensure drawings are in AUTOCAD.DXF or compatible format. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the fiber optic system. Include drawing details of fiber optic terminations in equipment rooms. Show final configuration, including location, fiber pair count, pathway innerduct arrangement, and pathway assignment of outside plant. Verify FO system is compatible with MIL-STD-188-176.

#### 2.1.1 Fiber Optic Cable Design

##### 2.1.1.1 Fiber Optic Media Types

Verify FO media meets all performance requirements of TIA-568.1, TIA-568.3 and the physical requirements of ICEA S-87-640 and TIA/EIA-598.

a. Multi Mode Fiber Media

Provide FO media with outer sheath jacket, strength member, ripcords, water blocking material, core tube, and core fibers as installed in a permanent underground pathway system as shown on the construction drawings. Provide FO media with an all glass, graded index material with a nominal core diameter of 50 microns. Provide a cladding material for the fiber which is compatible with the core. Center media transmission window at 850 and 1300 nanometer wavelengths, with attenuation at 1300 nanometers less than 2.0 dB per kilometer, and minimum bandwidth of 500 mHz-Km.

##### 2.1.1.2 Cable Length

Ensure cable is manufactured continuous with no factory splices.

##### 2.1.1.3 Construction

a. Inner Jacket

Locate buffer tubes concentrically around the cable central core member and covered with a polyethylene inner jacket. Ensure inner jacket is high density polyethylene in accordance with ASTM D4976. Fill space between the buffer tubes and inner jacket with a gel compound to prevent air, moisture, or water intrusion in the inner jacket.

b. Pulling Strength Member

Use a ramid type material as pulling strength members in the cable to provide pulling strength of at least 400 pounds for the cable during installation.

c. Cable Outer Jacket

Apply black medium density, high-molecular weight, polyethylene materials in accordance with ASTM D4976 longitudinally over all the inner jacket and sheathing strength member to form the cable outer jacket. Ensure outer jacket is smooth, concentric, non-nutrient to fungus, and free from holes, splits, blisters, or other imperfections. Overall outside cable diameter cannot exceed 0.75-inch.

2.1.2 Cable Identification Symbol

First of three lines on the ID symbol employ 5 characters.

First and second characters, from left to right, denotes the number of active optical fibers in the cable.

Third character is a slash.

Fourth and fifth characters denote optical transmission windows which the optical fiber can support. These windows are defined herein as follows:

a. Fourth character is an "A" or an "O." The "A" denotes a window at a wavelength of 850 nanometers (nm) with an attenuation of 4 dB/kilometer (km) and a bandwidth of 800 MHz-km. Use an "O" character if these requirements are not met.

b. Fifth character is a "B" or an "O." The "B" denotes a window at a wavelength of 1,300 nanometer (nm) with an attenuation of 1.0 dB/km and a bandwidth of 1,000 MHz-km. Use an "O" character if these requirements are not met.

Two lower lines of the cable ID symbol indicate multi-mode or single mode fibers, the cable number and the fiber count:

Example:

| | |
|---|---|
| 72/OB | Identifies the number of optical fibers (72) and the optical transmission window (OB - See preceding paragraph) |
| FM05 : 61-120 | Identifies Multi-Mode Fiber Cable 05 with MM Fibers 61 through 120. |
| FS05 : 13-24 | Identifies Single Mode Fiber Cable 05 with SM Fibers 13 through 24. |

2.1.3 Temperature Environment

Provide fiber optical cable compliant with the mechanical performance requirements herein while used in duct applications where the temperature varies from 17.6 degrees F to 100 F. Ensure optical performance degradation is less than five percent of the optical performance requirements in the temperature range of minus 4 degrees F to 140 degrees F. Do not damage fiber optical cable in storage where the temperature may

vary from minus 40 degrees F to 149 degrees F.

2.1.4 Splice Compatibility Test

When the material of the optic fiber is different from Cornings' Class Code No. 1517 for multi-mode graded index fiber and No. 1528 for single-mode fiber, perform and document the Splice Compatibility Test with Vendor as follows:

a. Select fiber samples from a minimum of 3 different production lots of the fiber type proposed for the job.

b. Fabricate and measure a minimum of 10 fusion splices using fiber from the different production lots and a sample of Corning fiber, Class Code No. 1517 and No. 1528, supplied by the Government.

c. Measure fusion splices using an Optical Time Domain Reflectometer (OTDR) operating in the region of 1250 through 1350 nm. Ensure the insertion loss of the fusion splice equals the average of two OTDR measurements, one taken with the OTDR installed on the Corning fiber, and the other with the OTDR installed on the vendor's fiber. Verify Vendor's fiber and the Corning fiber are each a minimum of 1 Km in length throughout the testing.

d. Consider vendor's fiber compatible with the Corning fiber if the maximum splice insertion loss of each of 10 fusion splices tested measures less than 0.2 dB.

   Allow a maximum of three retries on any one splice to obtain a loss of 0.2 dB or less.

Perform these tests under Government supervision.

2.2 EQUIPMENT

2.2.1 Pre-Connected Cable Assembly

Provide factory assembled pre-connectorized cable assembly to interface with the patch panel bulkhead feed-through receptacle. Provide dust caps for all terminated fibers.

Ensure multi-mode fiber optic cable assembly is comprised of a single fiber connector, terminated on three (3) meter length of single fiber, multi-mode cable. Verify single fiber cable contains a buffered optical fiber the same as that provided in the multi-fiber cable.

Ensure single fiber optic cable assembly is comprised of a single fiber connector terminated on the three (3) meter length of single fiber, single mode cable. Single fiber cable contains a buffered optical fiber, the same as that provided in the multi-fiber cable. Ensure return loss for single mode connectors is a minimum of minus 30dB.

Provide connector/cable interface on both the single and multi-mode cable assemblies able to withstand a tensile force of 25 pounds without detrimental affects on the connector loss characteristics.

Verify each connectorized cable assembly has a loss of less than or equal to 0.5 dB.

2.2.2 Optical Patch Panel Assemblies

Provide all cable terminations in optical patch panel assemblies, with patch panel assemblies of the pre-assembled chassis type with associated rack-mounting hardware.

To facilitate the transition between outside plant cable and the preconnectorized cable assemblies, ensure the fibers are fusion spliced and housed in a splice tray. Position splice tray in the optical patch panel assembly as indicated. Ensure splice attenuation does not exceed 0.2 db. Cover splice with a protective sleeve.

2.2.3 Fiber Optic Terminal Cabinets

Provide front recess only FOT cabinets. Cabinet's frame consists of vertical and horizontal tubular aluminum extrusions with a minimum wall thickness of .150-inches. Ensure front to rear aluminum extruded corners are at least .125-inches thick, and rear door, top panel, and side panels are a minimum of 18-gage steel. Provide cabinet with 14 gage steel, .281 inches punched panel/chassis mounting rails permitting recessed installation of equipment. Place cable entry and exit holes as indicated. Verify dimensions of cabinet and associated cabinet hardware are as indicated.

Provide gray color cabinet in accordance with SAE AMS-STD-595A.

2.2.4 Fiber Optic Enclosures

Provide metallic enclosures for fiber optic data transmission equipment. NEMA 250, type 4 enclosure. Protect the spliced fibers from moisture and physical damage. Splice closure provides strain relief for the cable and the fibers at splice points. Provide full documentation citing conformance to structural parameters.

2.2.5 Fiber Optic Terminations And Connectors

FO connectors to comply with TIA/EIA-4750000-C and TIA/EIA-604-3.

2.3 MATERIALS

2.3.1 Optical Fibers

a. Provide multi--Mode (MM) fiber of the step index optical glass type, with a core diameter of 50 plus or minus 3 micrometers. Cladding diameter is 125 plus or minus 3 micrometers. Ensure the core-cladding offset is less than 3 micrometer, and the minimum tensile strength of the fiber after primary protective coating is greater than 50,000 psi.

Softening point of the optical fiber clad material is 1630 degrees C plus or minus 50 degrees C in accordance with ASTM C338, or the optical fiber meets the requirements in paragraph SPLICE COMPATIBILITY TEST.

2.3.2 Fiber Primary Protective Coating

Coat optical fiber with suitable material to preserve the intrinsic high tensile strength of the glass fiber. Ensure outside diameter of the coated optical fiber is 250 (plus or minus 15) micrometer. Provide coating material which is readily removable, mechanically or chemically, without damaging the optical fibers when the removal is desired.

2.3.3 Optical Fiber Color-Code Coating

Coat primary protective coated SM and MM fibers with a color-code coating for individual fiber identification. Maximum outside diameter of color-code coated fiber is less than 300 micrometer.

2.3.4 Loose Tube Buffering

Surround color-code coated fibers with a loose tube buffering for protection from external mechanical and environmental influences. Fill interior of the tube with a suitable gel-fitting compound to prevent water migration. Color code loose tube buffering for the tube identification.

2.3.5 Colorants

Verify color concentrates or inks used to color code the optical fibers and the loose buffer tube are not susceptible to migration and chemical reaction with gel filling compound.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

2.4.1 Factory FO Quality Control

Provide conduit factory quality tests of FO media as required by TIA-472D000.

2.4.2 Factory Test Certificates

Provide fiber optical cable complying with the following optical and mechanical test requirements.

2.4.2.1 Optical Performance

a. Multi-Mode Fibers in the Cable

Verify optical attenuation of each optical fiber in the cable (reeled) is no greater than 1.0 dB/Km at 1300 plus or minus 50 nm optical spectrum window. Measure attenuation on completed cable reel length, and normalized linearly to 1 Km.

Verify bandwidth at minus 3 dB optical power of each optical fiber in the cable (reeled) is a bandwidth length product, gamma equals 1, greater than 1 GHz-Km at 1300 plus or minus 50 nm optical spectrum window.

Verify numerical aperture of each optical fiber is 0.2 plus or minus 0.015 at 1300 nm optical spectrum window. Ensure method of numerical aperture measurement is in accordance with TIA-455-177, at central wavelength 1300 nm nominal. When this requirement is not met, apply the fusion splice compatibility test.

2.4.2.2 Mechanical Performance

a. Minimum Bend Radius

Provide cable which withstands bending to a minimum radius of 10 times the cable outer diameter without tensile load applied, and of 20 times the cable outer diameter with maximum tensile load applied (during installation), without damage to cable components or degradation of the

optical fiber performance at room temperature.

b. Tensile Strength

Provide fiber optical cable which withstands a pull force of at least 400 pounds to be applied to the pulling strength member during the installation, and a tensile load of at least 300 newtons during operation without incurring any damage or detriment to fiber optical cable and optical performance. Ensure tensile strength test is in accordance with TIA-455-33.

c. Flexing or Bending Cycles

Provide fiber optical cable which withstands at least 20 bending cycles at minimum bend radius without damage to the fiber optic cable components or degrading optical performance. Ensure cyclic flexing test is in accordance with TIA-455-104.

d. Crush Resistance

Provide minimum crush resistance of the fiber optical cable greater than 650 newton/centimeter (cm) without damage to cable components or degrading optical performance. Ensure crush resistance test is in accordance with TIA/EIA 455-41-A.

e. Impact Resistance

Provide fiber optical cable capable of withstanding 20 impacts, at five newton-meters force, without damage to cable components, or degradation of optical performance. Ensure impact resistance test is in accordance with TIA/EIA-455-25.

2.4.3 Factory Reel Test

Test 100 percent OTDR test of FO media at the factory prior to shipment in accordance with TIA-568.1 and TIA-568.3. Use TIA-526-7 for single mode fiber and EIA TIA/EIA-526-14A Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Provide digitized or photographic traces to the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

Install and test the FO media in accordance with contract drawings, specifications, IEEE C2, NFPA 70, and TIA-590. Provide all necessary power, utility services, technicians, test equipment, calibration equipment as required to perform reel and final acceptance tests of the media. Replace all media which fails the factory or reel tests or final acceptance field tests and re-test at the contractors expense.

3.1.1 Contractor Damage

Promptly repair indicated utility and communications lines or systems damaged during site preparation and construction. When Contractor is advised in writing of the location of a non-indicated line or system, such notice provides 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 Installation in Cable Trays

Do not install communication cables in the same cable tray with ac power cables.

Install cables placed in cable trays in a neat and orderly manner and not crossed or interlaced with other cables except at breakout points.

Individually retain cables in vertical trays with straps at a maximum of 6 -feet on center.

3.1.3 Grounding Systems

Ground cables at each termination point or as indicated.

3.2 FIELD QUALITY CONTROL

3.2.1 Test Requirements

Ensure test equipment used for verifying installation testing is calibrated by a certified testing company within 3 weeks of use.

3.2.1.1 Single and Multi-Mode OTDR Test

Ensure the Optical Time Domain Reflectometer (OTDR) conforms to the following minimum requirements:

a. Operating wavelengths: 1,300 plus or minus 20 nanometers

b. Attenuation Range (one way): minimum 15 dB at 1,300 nm

c. Attenuation Resolution: 0.01 dB

d. Accuracy: plus 0.5 dB

Use OTDRs with digital readout capability and a means of providing a permanent record in the form of a photograph.

3.2.1.2 End-to-End Attenuation Tests

An attenuation measurement test set consists of an optical power meter and an optical power source. Provide attenuation measurement test set in accordance with the applicable National Bureau of Standards (NBS) standards for a stable optical source. Meter may be analog or digital. Include end-to-end attenuation test reading on the test reference loss. Ensure measurement test set conforms to the following minimum requirements:

a. Operating wavelengths: 1,300 plus or minus 10 nanometers

b. Attenuation Range: at least 30 dB at 1,300 nm

c. Attenuation Resolution: 0.01 dB

d. Accuracy: The accuracy of the attenuation measurement test set is plus or minus 5 percent.

Ensure optical source is capable of coupling sufficient power into the fiber so that the light received at the meter is within the meter

delectability limits.

3.2.1.3 End-to-End Bandwidth Tests

Ensure bandwidth test conforms to the following minimum requirements:

a. Operating wavelengths: 1,300 plus or minus 10 nanometers

b. Bandwidth range: minimum 1000 megahertz

c. Bandwidth Resolution: 1 megahertz

d. Accuracy: plus or minus 0.5 megahertz, Measurement Method: Swept Frequency

As a minimum, test each fiber cable before and after installation for any faults or attenuations using an Optical Time Domain Reflectometer (OTDR). Conduct end-to-end attenuation tests after complete installation.

Clearly state all test equipment, test procedures, and testing techniques in the quality assurance plan. Conduct tests in accordance with the approved Quality Assurance Plan. Ensure all field tests are witnessed by the Contracting Officer. Give Contracting Officer at least 20 calendar days notice prior to performing each test.

Provide each test sheet with a sign-off blank for both Contractor and the Contracting Officer. Deliver copies of the completed test forms and test results as indicated.

Record sequential cable markings along the cable on the sequential cable form, prior to and after each end of splice point,and submit for approval.

Submit test results on all installed fiber cabling before and after each pre-connectorized cable assembly splice is completed.

Maintain an accurate test record during all field tests.

3.2.2 Final Acceptance Tests

Perform end-to-end tests including power meter light source and OTDR tests. Perform OTDR measurements as required by TIA-568.1 and TIA-568.3. Test single mode fiber in accordance with TIA-526-7 (Optical Power Loss). Test multi mode fiber in accordance with TIA-526-14(Optical Power Loss).

3.2.2.1 Test Results

Provide results of final acceptance tests (attenuation tests, OTDR traces, etc.), to the Contracting Officer within 5 working days after completion of tests.

3.3 CLOSEOUT ACTIVITIES

Submit 2 copies of the Record (As-Built) Drawings to the Contracting Officer.

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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" 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

Test Plan; G-AE

SD-06 Test Reports

Draft Test Report

Final Test Report; G-AE

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.

1.4.1.5 Test Intruder

The purpose of the test intruder is to activate intrusion sensors in a realistic and repeatable manner. The test intruder must be between 70 and 72 inches tall and weigh between 175 and 190 pounds. The test intruder must possess sufficient physical strength, agility, and endurance to perform movements required for intrusion testing. These movements may include, but are not limited to, walking, running, crawling, jumping, and climbing.

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, Test Intruder, 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

Nofity 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, and Test Intruder. 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.

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SECTION 28 10 05

ELECTRONIC SECURITY SYSTEMS (ESS)
**05/16**

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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)

| | |
|---|---|
| ASC/X9 X9.52 | (1998) Triple Data Encryption Algorithm Modes of Operation |

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 C2 | (2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code |

INTELLIGENCE COMMUNITY STANDARD (ICS)

| | |
|---|---|
| ICS 705-1 | (2010) Physical and Technical Security Standard for Sensitive Compartmented Information Facilities |

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

| | |
|---|---|
| ANSI ISO/IEC 7816 | (R 2009) Identification Cards - Integrated Circuit Cards |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA 250 | (2020) 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 2020) 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; TIA 22-1; ERTA 1 2022) National Electrical Code |

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

| | |
|---|---|
| NIST FIPS 140-2 | (2001) Security Requirements for Cryptographic Modules |
| NIST FIPS 197 | (2001) Advance Encryption Standard |
| NIST FIPS 201-2 | (2013) Personal Identity Verification (PIV) of Federal Employees and Contractors |

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

| | |
|---|---|
| TIA-568.2 | (2018d) Balanced Twisted-Pair Telecommunications Cabling and Components Standards |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| DODI 8500.01 | (2014) Cybersecurity |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 47 CFR 15 | Radio Frequency Devices |

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 634 | (2007; Reprint Mar 2015) Connectors and Switches for Use with Burglar-Alarm Systems |
| UL 636 | (2018) UL Standard for Safety Holdup Alarm Units and Systems |
| UL 639 | (2007; Reprint Nov 2019) Standard for Intrusion Detection Units |
| UL 681 | (2014; Reprint Jan 2021) UL Standard for Safety Installation and Classification of Burglar and Holdup Alarm Systems |
| UL 796 | (2020; Reprint Mar 2022) UL Standard for Safety Printed Wiring Boards |
| UL 1037 | (2016; Reprint Sep 2017) UL Standard for Safety Antitheft Alarms and Devices |

| | |
|---|---|
| UL 1076 | (2018; Reprint Feb 2021) UL Standard for Safety Proprietary Burglar Alarm Units and Systems |
| UL 1610 | (2016; Reprint Apr 2021) UL Standard for Safety Central-Station Burglar-Alarm 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:

The USAF will review and will approve submittals requiring special review in this section.

SD-02 Shop Drawings

ESS Components; G-AE

Overall System Schematic; G-AE

SD-03 Product Data

Premise Control Unit; G-AE

Detection Sensors; G-AE

Access Control Unit; G-AE

Access Control Devices; G-AE

Communications Interface Devices; G-AE

Video and ESS Transmission; G-AE

Batteries; G-AE

Component Enclosure; G-AE

SD-05 Design Data

Backup Battery Capacity Calculations; G-AE

Access Control Throughput Rates; G-AE

SD-07 Certificates

Contractor Qualifications; G-AE

Instructor Qualifications; G-AE

Data Encryption; G-AE

SD-10 Operation and Maintenance Data

Training Plan; G-AE

Training Content; G-AE

ESS Components and ESS Software: Data Package 4; G-AE

ESS Software and ESS Components: Data Package 4; G-AE

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA

SD-11 Closeout Submittals

As-Built Drawings; G-AE

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 Sand and Dust

Wind driven for up to 6 miles per hour (mph)

1.4.2.5 Rain

2 inches per hour and 5 inches per hour cyclic with wind plus one period of 12 inches per hour

1.4.2.6 Humidity

5 to 95 percent

1.4.2.7 Fungus

Warm, humid atmosphere conducive to the growth of heterotrophic plants

1.4.2.8 Salt Fog

Salt atmosphere with 5 percent salinity

1.4.2.9 Snow

Snow loading of 48 (psf) per hour; blowing snow of 4.6 psf per hour

1.4.2.10 Ice Accretion

Up to 1/2 inches of radial ice

1.4.2.11 Wind

Continual velocity up to 50 mph with gusts to 66 mph, except that fence sensors must detect intrusions up to 35 mph

1.4.2.12 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.

1.6 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.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a complete and integrated electronic security system (ESS) that the meet requirements of the UFC's and Security in Depth. ESS must be compatible with the Installation's central monitoring system and monitored

within the secure/protected area at the Installation central monitoring station. Installation's central monitoring system is manufactured by Vindicator. ESS consisting of the following subsystems and features:

a. Intrusion Detection System (IDS)

b. Access Control System (ACS)

c. Communications System

Include materials not normally furnished by the manufacturer with the ESS equipment as specified in:

a. 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, 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 Hazardous Locations

When located in areas where fire or explosion hazards exist, provide system components rated and installed according to Chapter 5 of NFPA 70.

2.2.3 Network Certification

Certify all Platform Information Technology (PIT) in accordance with DODI 8500.01 and the individual service implementation policy.

2.2.4 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.

2.2.5 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.

2.2.6 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.

2.2.7 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.

2.2.8 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 to clearly identify the component experiencing power loss.

2.2.9 Controls and Designations

Provide controls and designations as specified in NEMA ICS 1.

2.2.10 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.

2.2.11 Electromagnetic Interference (EMI)

Configure and provide ESS components employing electromagnetic radiation constructed to provide minimal vulnerability to electronic countermeasures.

2.2.12 Electromagnetic Radiation (EMR)

Provide only ESS communication components which are Federal Communications Commission (FCC) licensed and approved. Provide system components which are electromagnetically compatible.

2.2.13 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 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. The IDS must be fully compatible with the base's Vindicator Command System v3 manufactured by Honeywell.

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.

### 2.3.1 IDS Components

Provide components:

a. Premise Control Units (PCU)

b. Detection Sensors

c. Tamper Switches

### 2.3.2 Detection Sensitivity

The sensitivity of the IDS must allow for the following:

a. Locating intrusions within 35 feet zones along a line or perimeter to one side of the building

b. Locating intrusions at individually protected assets or at an individual portal

c. Locating intrusions within the coverage on a single volumetric sensor

d. Locating failures or tampering at individual sensors

### 2.3.3 Detection Alarm and Reporting Capacity

Collect, communicate, and display up to 32 sensor zone alarms and to enable control of two card reader with integral keypad for secure and access inside of the protected area with a delayed alarm.

Identify individual sensors in alarm if the sensor zone is a multiple alarm source combination. Annunciate a single alarm within 2 seconds maximum, after sensor transducer or other detection device activation.

### 2.3.4 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.

2.3.5 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.

2.3.6 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. Keypad(s)

e. Keypad connection cable(s)

f. Additional components as required for full functionality

2.3.6.1 PCU Capabilities

Provide the PCU at a minimum but not limited to, the following capabilities;

a. Expansion to a total of at least 10,000 user codes with 99 user profile definitions.

b. Support 4 keypads with alphanumeric display. Each keypad must be capable of arming and disarming any system area based on a pass code or access control card and or key FOB authorization. Provide keypad alphanumeric display with complete prompt messages during all stages of operation and system programming and display all relevant operating and test data.

c. Four 4 shift schedules per area.

d. A total of at least 100 programmable output relay schedules.

e. 32 individual reporting areas.

f. Data line supervision.

g. Two-man access code or credentials.

h. Support programming to require the same or different access code entered within a programmed delay time of 1 to 15 minutes after disarming before activating a silent ambush alarm.

i. Support area programming that disables schedule and time-of-day changes while system is armed so that area can only be disarmed during scheduled times.

j. Provide a minimum of a 4,000 event log buffer per PCU. Record and hold alarm activity information in the log buffer until the ESS is

connected and receives the information. Provide a software-configurable warning log buffer filling notification for PCU(s) configured with network switch capabilities.

k. Support a Network Interface Card (NIC) plug-in module with built in network router capable of 128 Bit AES Rijndael Encryption process certified by NIST (National Institute of Standards and Technology).

2.3.6.2 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.

2.3.6.3 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.

2.3.7 Detection Sensors

a. Sensors are to detect facility perimeter or protected zone penetrations by unauthorized personnel or intruders and transmit an alarm signal to the alarm annunciation system upon change detection. Accomplish this with a probability of detection (PD) of 0.9 with a 95 percent confidence level and conforming to UL 639 where applicable.

b. Required sensor power is 12 VDC unless otherwise specified.

c. An interior IDS zone is a room or space within a building that can be

armed and disarmed independently from all other zones.

d. 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.

d. 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".

2.3.7.1 Interior Sensors

2.3.7.1.1 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.

2.3.7.1.1.1 Level 1 Switch

UL 634. Level 1 High Security

2.3.7.1.1.2 Level 2 Switch

UL 634. Level 2 High Security

2.3.7.1.2 Passive Infrared Sensors

UL 639.

2.3.7.1.3 Microwave Sensors

UL 639.

2.3.7.2 Duress Alarms (Hold Up Switch)

UL 636. Duress alarm switches must provide the means for an individual to covertly notify the alarm annunciation system that a duress situation exists with no visible or audible signal in the secure area.

2.3.7.3 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

(4) Boxes

(5) Raceways

(6) Fittings

(7) Sensors

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 not have a maintenance position.

2.3.7.3.1 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 by zone at the central reporting processor.

2.4 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. The ACS must be fully compatible with the base's Vindicator Win-Pak access control system manufactured by Honeywell.

a. The ACS card credentials are required to be Common Access Cards (CAC), and CAC cards are being provided by the Government. Provide system monitoring and control for the ESS. Provide ACS that meets the communications requirements of UL 1076 and UL 294 and has the capability of controlling up to 8 card readers and keypads per card reader controller, 256 alarm inputs, or 256 relay outputs or any components combination.

b. System is to grant or deny access or exit based upon:

(1) Keypad identification data

(2) CAC PIV card identification data

(3) Video

(4) Biometric reader identification data

(5) Smart card identification data

(6) Identification technologies combination

(7) Input through the access control devices compared to data stored within the system

(8) 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. Access decisions for high security areas are to be based upon two identification technology combinations: card and keypad or card and biometric.

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.

2.4.1 ACS Programming

Provide software capable of, but not limited to, the following programming:

2.4.1.1 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.

2.4.1.2 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.

2.4.1.3 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.

2.4.1.4 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.

2.4.1.5 Maximum User Capability

Up to 64,000 individual users may be given access cards or codes and have their access controlled and recorded.

2.4.1.6 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.

2.4.1.7 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.

2.4.1.8 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.

2.4.1.9 Door Outputs

Provide each access control reader with one 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.

2.4.1.10 Anti-Passback

Provide global anti-passback capability. Any door on the system can be linked to one of 256 user defined passback areas or two 2 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.

2.4.1.11 Two Person Rule

Any access control reader on the system is to have the ability via software programming to require two valid cards for access. Any access control reader on the system that includes a keypad is to also have the ability to require a valid PIN number associated with each of the two valid cards.

2.4.1.12 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.

2.4.1.13 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.

2.4.1.14 Door Groups

Allow up to 256 door groups to be configured. Doors belonging to the same group are be able to be locked, unlocked, disabled, and enabled on command from the ACS.

2.4.1.15 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.

2.4.1.16 PIN Required

Provide support for the required use of a keypad code, in addition to a valid credential during user-selected schedules.

2.4.1.17 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.

2.4.1.18 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.

2.4.1.19 Guard Tour

Provide support for user-defined guard tours configurable in a set pattern of tour points, or following a mode in which all tour points can be visited in any order within an allotted time. Allow for a tour to be started by ACS command, by use of a selected card at a selected reader, or by use of a selected keypad code at a selected keypad. Detect guard late-to-point, point missed, and point out-of-sequence events. Generate a report at tour completion.

2.4.1.20 Reader Disable

Provide support for disabling readers in reaction to a user-selected number of invalid access attempts.

2.4.1.21 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.

2.4.1.22 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.

2.4.1.23 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.

2.4.1.24 Remote Input Control

Provide the operator the capability of manually controlling any alarm, input point, alarm partition or group by issuing a simple command from the SCC on the ACS allowing the ability to shunt, unshunt, disable and restore any input in this manner. This activity must cause an entry to be logged displaying the input name and time that it was performed. The arm and disarm, shunt and unshunt any alarm partition or group from the SCC must not be permissible in ICS 705-1 applications. The operator cannot have the capability to shunt or disable a tamper alarm.

2.4.1.25 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.

2.4.1.26 Remote Output Control

Provide the operator the capability of manually controlling any output point by issuing a simple command from the SCC. Based upon the output type, provide the ESS operator the ability to ENABLE, DISABLE, turn ON and turn OFF any output in this manner. A FOLLOWS type output must not be capable of being turned OFF or ON. Log an entry when this activity is performed displaying the output name and time performed. Manual control of outputs are not permissible in ICS 705-1 applications.

2.4.1.27 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.

2.4.1.28 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.

2.4.1.29 User-Selected LED Behavior

Allow the user to select different behaviors for the LEDs of each access controlled reader.

2.4.1.30 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.

2.4.1.31 Badge Print Tracking

Support setting a print limit for any badge. The software will track the number of times any badge has been printed, as well as display the date and time of the most recent printing.

2.4.2 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.

2.4.3 Access Control System Central Processing

a. 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 subsystem monitoring, management, and control functions.

c. Provide enrollment equipment as required in paragraph ENROLLMENT CENTER EQUIPMENT.

d. 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.

2.4.4 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 one ACU as "Primary", responsible for all ACS-to-ACU communications. All other ACU(s) up to a maximum of 16 are to be designated as "Secondary" and communicate with the "Primary" via an TCP/IP network. 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 2 ports and be expandable in increments of two ports up to a maximum of 4 ports per ACU.

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) Elevator Reader

(5) Elevator Output Module

Any device combination can be supported on each ACU, up to a total of 2 devices per ACU.

d. Capability of supporting multiple card reader technologies simultaneously, including:

(1) Keypad

(2) Card and Keypad

(3) CAC PIV compatible

(4) Biometrics

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.

f. Powered by a 12 VDC power source rated at a minimum of 2 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 strikes, other locking devices and ancillary peripherals on a separate power supply with battery back-up for continued operation in the event of power failure as specified in paragraph "Backup Power".

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.

2.4.5 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.

2.4.5.1 Card Readers

Provide surface, or weatherproof mountable card readers as indicated for each individual location. Provide contact and contactless type card readers capable of reading CAC PIV and Keypad CAC PIV cards type of access control cards.

Keypads must contain an alphanumeric and special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence. Provide keypad integrated into the card reader.

2.4.5.1.1 Contact Card Readers

Provide contact card readers that can read credential PIV CAC cards whose characteristics of size and technology meet those defined by ANSI ISO/IEC 7816 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.

2.4.5.1.2 Contactless Card Readers

Provide contactless card readers that can read credential PIV 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.

2.4.5.1.3 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.

2.4.5.1.4 Card Reader Response Time

The card reader is to respond to passage requests by generating a signal to the local processor.

2.4.5.1.5 Card Reader Power

Power the card reader from the source as shown on the drawings. The card reader must not dissipate more than 5 Watts.

2.4.5.1.6 Card Reader Mounting Method

Provide card readers suitable for surface or weatherproof mounting as required.

2.5 COMMUNICATIONS

a. Communications are to link together subsystems of the ESS and be in accordance with Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. Interfaces between subsystems cannot be accomplished by use of an electro-mechanical relay assembly. Communications links must be supervised. Provide common communications interface devices throughout the ESS. Provide dry contact sensor to control unit interface that is normally OPEN or normally CLOSED, except as specified otherwise.

b. 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.

c. 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.

2.5.1 Link Supervision

2.5.1.1 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.

2.5.1.2 Hardwire Alternating Current Supervision

Supervision is not to be capable of compromise by use of resistance, voltage, or current substitution techniques. Use this method on circuits which employ a tone modulated frequency-shift keying (FSK), interrogate-and-reply communications method. Supervisory circuit are to be immune to transmission line noise, crosstalk, and transients. Terminate detection circuit by complex impedance. Maintain line supervision by monitoring current amplitude and phase. Size complex impedance so that current leads or lags the driving voltage by 45 plus or minus 5 degrees.

Alarm when rms current changes by more than 5 percent, or phase changes by more than 5 degrees for supervision current of 0.5 to 30 milliamperes rms. Alarm when rms current changes by more than 10 percent, or phase changes by more than 8 degrees for lines with supervision currents of 0.01 to 0.5 milliamperes. Identified line supervision alarm must be communicated within one second of the alarm.

2.5.1.3 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.

2.5.2 Hardwire

2.5.2.1 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. 16 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.

2.5.2.2 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 at a data rate of 10.24 kilobaud.

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, 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 7500 feet when operating without line repeaters or other signal regenerating or amplifying devices. The communications system must maintain specified performance over a link length of 75,000 feet when operating with signal-regenerating line repeaters.

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- or four-wire |
| 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 speed | 10.24 kilobaud |
| Maximum loss at 1000 Hz | 33 dB |

2.5.3 Data Encryption

Incorporate data encryption equipment on data transmission circuits as shown on the drawings. The algorithm used for encryption must be the Advanced Encryption Standard (AES) algorithm described in NIST FIPS 197 of TDES, ASC/X9 X9.52, as a minimum. Data encryption must be in accordance with NIST FIPS 140-2.

2.5.4 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 Section 27 13 23.00 40 COMMUNICATIONS OPTICAL BACKBONE CABLING.

Install interior cable in Electrical Metallic Tubing (EMT) conduit unless indicated otherwise. Cable is to be rated for the installation method intended. Install exterior cable underground installed in Schedule 80 Polyvinyl chloride (PVC) conduits.

2.5.5 Wire and Cable

Provide all wire and cable not indicated as Government-furnished equipment. Wiring must meet NFPA 70 standards and as indicated in the Wire and Cable Data Sheets Attachment at the end of this section.

2.5.6 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 27 13 23.00 40 COMMUNICATIONS OPTICAL BACKBONE CABLING.

2.5.7 Aboveground Sensor Wiring

Sensor wiring is to be 20 AWG minimum, twisted and shielded, 2, 3, 4, or 6

pairs to match hardware. Provide multiconductor wire with a PVC outer jacket.

2.5.8 Direct Burial Sensor Wiring

Sensor wiring is to be 20 AWG minimum, twisted and shielded, 2, 3, 4, or 6 pairs to match hardware.

2.5.9 Local Area Network (LAN) Cabling

Cabling must be in accordance with TIA-568.2, Category 6.

2.5.10 Cable Construction

Provide all cable components that will withstand the environment in which the cable is installed for a minimum of 20 years.

2.6 BACKUP POWER

a. Intrusion alarms are not to be generated as a result of power switching; however, Provide a power switching indication and on-line source at the alarm monitor.

b. The system is to automatically switch back to the primary source upon primary power restoration. Detect and report failure of an on-line battery as a fault condition. Power products must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

c. Provide backup power to the primary power by backup batteries in each element or subsystem.

2.6.1 Batteries

Provide backup by dedicated batteries in remotely located system elements including individual sensors or control units. Batteries are to be an integral part of dispersed system elements when radio frequency (RF) operation is required. Batteries are to be capable of operation in any position and be protected against venting caustic chemicals or fumes within an equipment cabinet. Provide batteries capable of continuous operation for up to 8 hours without recharge or replacement.

2.7 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

2.7.1 Interior Sensor

Provide sensors to be used in an interior environment with a housing that provides protection against dust, falling dirt, and dripping noncorrosive liquids. Refer to paragraph "Interior Enclosures" for enclosure ratings.

2.7.2 Exterior Sensor

Provide sensors to be used in an exterior environment with a housing that provides protection against windblown dust, rain and splashing water, and hose directed water. Sensors are not to be damaged by the ice formation on the enclosure. Refer to paragraph "Exposed-to-Weather Enclosures" and "Corrosion-Resistant Enclosures" for enclosure ratings.

2.7.3 Interior Enclosures

Enclosures to house equipment in an interior environment must meet the requirements of NEMA 250 Type 12.

2.7.4 Exposed-to-Weather Enclosures

Enclosures to house equipment in an outdoor environment must meet the requirements of NEMA 250 Type 4X.

2.7.5 Corrosion-Resistant Enclosures

Enclosures to house equipment in a corrosive environment must meet the requirements of NEMA 250 Type 4X.

2.7.6 Hazardous Environment Equipment

All system electronics to be used in a hazardous environment must be housed in a metallic enclosure which meets the requirements of paragraph "Hazardous Locations."

2.7.7 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.

2.7.8 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.

2.7.9 Ventilation

Ventilation openings in enclosures and cabinets must conform to requirements of UL 1610.

2.7.10 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.

2.7.11 Labels

Label boxes containing connections that they contain ESS connections and indicate that the box is part of the ESS system.

2.7.12 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.

2.8 LOCKS AND KEY LOCK

2.8.1 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.

2.8.2 Key-Lock Operated Switches

All key-lock-operated switches required to be installed on system components are to be UL 437, 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.". Key-lock-operated switches are to have two positions, with the key removable in either position. Key all key-lock-operated switches differently and furnish only two keys for each key-lock-operated-switch.

2.8.3 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.

2.9 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.

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.

2.9.1 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.

2.10 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 memory stick of all accepted software, including diagnostics, upon successful endurance test completion.

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 Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, ICS 705-1, 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 and ICS 705-1. Install exterior conduits in accordance with NFPA 70, Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION and ICS 705-1.

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 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 overlapping and 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) Two eight-hour on-site training sessions

    (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) Four (one-day) 8 hour on-site training sessions

(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

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.

3.6.6 Follow-up Training

a. Provide One hour training session each month for two months after initial training.

b. Follow-up training is to begin one month after initial training.

c. Training is to include testing for system competence.

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 --

# DEPARTMENT OF THE AIR FORCE

AIR FORCE LIFE CYCLE MANAGEMENT CENTER (AFMC)
HANSCOM AIR FORCE BASE, MASSACHUSETTS

28 January 2021

MEMORANDUM FOR DISTRIBUTION

FROM: Force Protection Division, AFLCMC/HBU

SUBJECT: Non-Nuclear Configuration Management Database (CMD) Equipment Approval

1. The CMD equipment listed below is approved for use when employed in the tested PL-1 Non- Nuclear through PL-4 applications and configurations (information can be obtained from AFLCMC/HBU). This letter consists of nine pages.

***** Indicates correction, change, and/or addition.

+ Indicates item is no longer procurable and/or supported by Original Equipment Manufacturer (OEM). NOTE: Items marked with a (+) are no longer authorized for purchase; however, previously installed systems will remain on this list as legacy systems and for fixed site sustainment support IAW with AFI 31-101, Chapter 9. Contact AFSFC/S5G at afsfc.ibdss@us.af.mil with any questions concerning these items.

## PL-1 Non-Nuclear and Below

### Command, Control Display Equipment (CCDE)

*** LINX Annunciator (formely known as Will-Burt Annunciator):**

*LINX Annunciator Predator Elite, with integrated access control
Annunciator Version 3.2.274p, subpatch p32274.1.13
LINXSNMP version 3.3.274P, subpatch 3.3.274P.1.13.30
Annunciator Version 3.3.274p, subpatch p33274.1.13.33
+ Annunciator Version 3.2.274p
+ Annunciator Version 3.0.252
+ Annunciator Version 3.0.246
Annunciator Version 8.1(Win 10)
+LINX Predator Enrollment System Version 4.1.220
+LINX Predator Enrollment System Version 4.0.203
LINX Versatile Interface Panel (VIP) Version 1.172
LINX Versatile Interface Panel (VIP) Version 1.148
+LINX Versatile Interface Panel (VIP) Version 1.64
LINX Versatile Interface Panel, Expandable (VIP-E) Version 7.284
LINX Versatile Interface Panel, Expandable (VIP-E) Version 7.145
+WSD 2000 Card Reader version 1.8V
WSD-E Card Reader version 3.110

**Advantor Annunciator:**

+ Advantor Advantage Suite for Networks (ASN) Version 4.0
+Advantor Advantage Suite for Networks (ASN) Version 5.0
+Advantor Integrated Command, Control, and Access Control System Version 5.0

+Advantor Integrated Command, Control, and Access Control System Version 5.0 Service Pack 6
Advantor Integrated Command, Control, and Access Control System Version 6.0
Advantor Advantage Suite for Networks (ASN) Version 6.2 (Win 10)

**Vindicator Annunciator:**

Vindicator Security Management and Reporting Terminal (SMART) Annunciator with Graphics Display
+ Version 2.40 with Administrative Browser 4.0
+ Version 2.43, Build 11
+ Vindicator Command and Control (VCC) Version 1.0.1.5
+ Vindicator Access Control System (ACS) Version 2.3, Build 21
+ Transponder Firmware Version 2.28
+ TS 4000 Radio Frequency (R/F) Modem Interface
+ Vindicator SMART with Graphics Display Version 2.39 and SAW Version 3.9
+ Vindicator Command and Control Platform (VCCP) v5- Version 5.0
+ Vindicator Command and Control Platform (VCCP) v5- Version 6.0
+ Vindicator Command and Control Platform (VCCP) v5- Version 6.5 (Win 7, 32 bit only)
+ Vindicator Command & Control (VCC) GUI Version 5.1.1.4
+ Vindicator Badge Manager 2 (VBM 2) Version 2.0.7.0
+ Vindicator Badge Manager 2 (VBM 2) Version 2.0.7.1 (Win 7, 32 bit only)
Vindicator Security Archive Workstation (SAW 5) Version 5.1.0.6
+ Honeywell Vindicator Site Commander Version 1.2.0.1
+ V5 IDS Network Security Appliance – Intrusion Detection, Revision 3.2, Release 20:
    UHS-8270
    DES-8270T
    AES-8270T
+ V5 ACS Network Security Appliance – Access Control Revision 3.2 Release 20:
    UHS-1401
    DES-1401T
    AES-1401T
+ Vindicator UHS-Net Gateways:
    UHS-8101 Version 2.33, Build 7
    UHS-8102 Version 2.33, Build 6
    UHS-8301 Version 2.33, Build 13
    UHS-8400 Version 2.33, Build 13
+ Vindicator UHS-Net Transponder/Gateway Revision 3.3, Release 5:
    UHS-1500
    DES-1500T
    AES-1500T
+ Vindicator UHS-Net Transponders Version 2.33, Build 13:
    UHS-6842
    UHS-6842F
    DES-6842
    DES-6842F
+ PC SMART PAC Software Package Version 5.1
+ Proteus 5 & SmartSave 5 Software Programs Version 5.2
Vindicator Command and Control Platform (VCCP) Windows 7 (64-bit):
    Vindicator Command & Control 2-Version 1.2.1.4
    V5 Network Security Application for IDS & ACS-Version 3.2, Release 23
    UHS-1500 UHS-Net Field Panel-Version 3.3, Release 7
    Security Archive Workstation 2-Version 1.4.2.9
    Vindicator Badge Manager 3-Version 2.0.26.7
    Vindicator Site Commander-Version 1.3.0.7
    Vindicator Area Commander-Version 1.1.0.6

Vindicator Premise Controller-Version 3.3, Release 7
Vindicator PC SMART PAK-Version 6.0.0.1
Vindicator Security Server-Version 1.0
Vindicator 10 Annunciator Workstation (Win 10 LTSB)
Vindicator Command and Control 2-Version 1.3.0.2 SP4
Vindicator Security Server-Version 1.0
V3 Head-End Server (IDS & ACS)-Version 4.3.2 SP VR11
V5 Network Security Appliance-Version 4.5.2 SP VR11
AES-1500Network Field Device-Version 4.3.2 SP VR11
Security Archive Workstation 2-Version 1.4.3.0
Vindicator Badge Manager 3-Version 2.0.26.7
Vindicator Site Commander-Version 1.3.0.7
Vindicator Area Commander-Version 1.1.0.7
Vindicator Premise Controller-Version 4.3.2
Vindicator PC Smart PAC (PCSP)-Version 6.0.0.1
Vindicator System Terminal-Version Win 10 LTSB

**LENEL Annunciator:**

LENEL OnGuard Version 7.5 with Milestone Version 12.3
**NOTE: Not approved with any Ground Based Radars**

**Assessment Subsystems:**

**Video Servers:**

Advantor Video Management System (VMS) Software (For use only with Advantor ASN 6.0):
Advantor VMS Version #va-advantorvms-3.3.22-1 (1/el5)
Advantor VMS Wall Version ds-vmx-3.3.1-3
+Bosch Allegiant Matrix/Control System LTC 8600 and 8800
+ Broadware 4.80 / Cisco 5.1.1. Video Storage System (NOTE: Cisco renamed the 4.80 after purchasing Broadware.)
+Video Image Control and Display System (VICADS) Version 4.0 Video Management System
+Prometheus Security Group Global Inc. (PSSGI) (Formerly Open Roads Consulting, Inc.) Video Image Control and Display System (VICADS) Version 4.1 Video Management system using Vindicator V5, Version 6 as the annunciator
+PSSGI Video Image Control and Display System (VICADS) Version 4.1 Service Pack 1.6 Video Management system using Vindicator V5, Version 6.5 as the annunciator
+PSSGI Video Image Control and Display System (VICADS) Version 4.1 Service Pack 1.6 Video Management system using Lynx Predator Elite Version 3.2.274p, subpatch p32274.1.13 as the annunciator
+PSSGI Video Image Control and Display System (VICADS) Version 4.2.7 build 134 using Lynx Predator Elite Version 3.3.274p, subpatch p33274.1.13.33
PSSGI Video Image Control and Display System (VICADS) Version 4.2.7 build 134 using Vindicator 7 as the annunciator
+PSSGI Video Image Control and Display System (VICADS) Version 4.1 Service Pack 2.0 Video Management system using Vindicator VCCP Windows 7 as the annunciator. Note: *DefendIR Thermal imager protocol support, RadarWall, and Geoserver are not approved for use*
+PSSGI Video Image Control and Display System (VICADS) Version 4.1 Service Pack 2.4 Video Management system using Vindicator VCCP Windows 7 as the annunciator. *Note: DefendIR Thermal imager protocol support, RadarWall, and Geoserver are not approved for use.*
PSSG Video Image Control and Display System (VICADS) Version 4.3 using LPE v8.1 (Win 10)
PSSG Video Image Control and Display System (VICADS) Version 4.3.2 using Vindicator (Win 10)

**Assessment Cameras:**

Axis Q1645 Fixed Camera
* Axis P3245-LVE
* Axis Q3527-LVE
* Axis Q6075 Indoor PTZ
* Axis Q6075-E Outdoor PTZ
* Axis Q6215-LE PTZ
Bosch 8001 Fixed Thermal Camera (Model:NHT-8001-F35VF)
Bosch MIC IP Starlight 7100i (Model:MIC-7522-Z30W)
+ Bosch NWC-04-95-20P Internet Protocol (IP) Camera
+ Bosch NWC-04-95-20P (1/3 Format)
+ Bosch NBN-498-21P Internet Protocol (IP) Camera
Bosch Auto Dome IP Starlight 7000i Camera (Model:NDP-7512-Z30)
+ Bosch Auto Dome VG 4-322-ECE1M
+ Bosch Auto Dome VG5-623-ECS
+ Bosch Auto Dome VG5-624-ECS
+ Bosch Auto Dome VG5-724-ECE2
+ Bosch Auto Dome 7000 Internet Protocol (IP) Camera with environmental housing
+ Bosch Dinion Internet Protocol (IP) 7000 Camera with environmental housing
Bosch DINION Internet Protocol (IP) Starlight 7000 HD (NBN-73013-BA)
Bosch NBN-63013-B
Bosch NBN-63023-B
* Bosch Flexidome Starlight 8000
+ Bosch NBN-71013-B
+ Bosch NBN-71022-B
+ Burle 300H Camera
+ Burle TC 351 Camera (1/2 inch format)
+ Cohu 4865 Camera (WS3) (2/3 inch format)
+ Cohu 48x Camera (KUMMSC) (2/3 inch format)
+ Cohu 4915/4912-3000 Camera (1/2 inch format)
+ Cohu 3930HD
+ Indigo Vision 512147 (PTZ)
+ Indigo Vision 11650-Audio-HD
+ IQ Eye 752 Internet Protocol (IP) Camera
+ Lumenera Le 165M-DN Internet Protocol (IP) Camera
+ Lumenera Le 165ME-DN Internet Protocol (IP) Camera with environmental housing
+ Lumenera Le 165MP-DN Internet Protocol (IP) Camera with environmental housing
+ Pelco ES31CBW35-2N Pan Tilt Zoom (PTZ) System
+ Pelco ES30C/ES31C Pan Tilt Zoom (PTZ) System (1/4 inch format) with/ without optional Wiper
+ Pelco ES4136-2N Esprit ES system Pan Tilt Zoom (PTZ) System (1/4 inch format) with/ without optional Wiper
+ Pelco MC3651H-2 Interior Camera (1/3 inch format)
+ Pelco IXE20 IP Camera
+ Pelco ES4036-5W Esprit Series, with and without wiper, standard and pressurized
+ Pelco ES40E36-5W Esprit Series, with and without wiper, standard and pressurized
+ Pelco ES40/41 Series Positioning System, Analog, PTZ, w/wo wiper Esprit SE Standard & pressurized, model ES4036-5W
+ Pelco ES40E/41E Series Positioning System, IP, PTZ, w/wo wiper Esprit SE Standard & Pressurized, Model ES40E36-5W
+ Pelco IXE21 Internet Protocol (IP)
Pelco P1220-ESR1 (PTZ)
Pelco Sarix IXE Series Box Cameras w/ SureVision 3.0

VICON SN680D-B-WNIR (PTZ)
+ VICON IQ762WI-V6 Internet Protocol (IP)
+ Vivotek IP 7151
+ Vivotek SD8364E (PTZ)
+ Vivotek IP816A-HP (interior only)
Vivotek IP9165 HP Fixed Camera

**Interior Sensors:**

**NOTE:** Balanced Magnetic Switch (BMS) will not be used as a line of detection.

+ AN/GSS-20 Volumetric
+ AN/GSS-9(V) SA 1955 BMS
+ AN/GPS-15(V) Closed-Shelter Aircraft Sensor (C-SAS) (Volumetric)
+ AN/GSS-36(V) Open-Shelter Aircraft Sensor (O-SAS) (Volumetric)
Banner Engineering Series Active Infrared (AIR), intrinsically safe, Model SMI30 (*Must be installed as an array of individually reporting sensor points, for use across openings in areas where explosive fumes may be present)*
+ Bosch DS 9370 PIR/MW (Volumetric)
+ Bosch DS 939 PIR (Volumetric)
BEA LZR-s600
BEA LZR-i30
Dortronics 1110 xD xCT, Magnetic Lock/BMS
Dortronics 1120 x2D xCT, Series Electromagnetic Lock and BMS
Eltec 862 Passive Infrared (PIR) Sensor (Wall)
Fiber Sensys EX-35T Passive Infrared (PIR)
Fiber Sensys AP2-20N Passive Infrared (PIR)
Fiber Sensys LD308SH
Fiber Sensys LD204S
+ General Electric (Sentrol) Model 2700 Series BMS
+ General Electric (Sentrol) Model 2807T Explosion Proof Balanced Magnetic Switch (BMS)
+ General Electric (Sentrol) Model 2507AH-L Wide Gap BMS
+ General Electric (Sentrol) Model 2800 Series BMS
+ General Electric AP669 PIR (Volumetric)
Magnasphere, High Security Sensor (HSS) Door Contact Switch, BMS, Version HSSL2S000
Magnasphere L2C-101 (Concealed switch)/L2C 101A (Recessed Switch) Magnetic Contact Switch
Magnasphere Interior Barrier Sensor Model MSK-101-MM
Magnasphere Interior Motion Sensor Model MSK-101-MM
+ PL&E Communications AVT 234 (VMD) using Dinion analog infrared imagers, for interior applications only
ASSA ABLOY (Securitron Group) MSS-1 High Security Balanced Magnetic Switch
East Coast Security Products Inc. ESM-6T Tandem Balanced Magnetic Switch
Protech Passive Infrared and Microwave Intruder Detectors (PIRAMID) SDI-76-G (Volumetric)
Protech Passive Infrared and Microwave Intruder Detectors (PIRAMID) SDI-77-D (Volumetric)
Protech SDI-76M-HS1-H Volumetric (Coverage 60'x 40', Two Sensors in Combination)
Protech SDI-76MW Volumetric (Coverage 60'x 40', Two Sensors in Combination)
Protech SDI-77XL2-EX, Explosion Proof Volumetric
Redscan RLS-3060SH Laser Scan Detector (*Approved for wall and ceiling configurations*)
+ SightLogix SightSensor Video Motion Detection (VMD) using NS-90A Thermal Imager, for interior applications only.
+ United Technologies Interlogix AP669 Mirror Optic PIR (Volumetric)
+ Visonic CH-1000 (Wall)
+ Visonic CH-1000/Xtalis ADPRO 18 WH PIR Combination (Ceiling) (Coverage 30'x 30')
Tyco Visonic Disc 360 Passive Infrared Sensor (Ceiling) (Coverage 360 Degree)

Maxiris 3000/3100 Active IR Interior Sensor
+ AN/GSS-39(V) Interior Intrusion Detection System. Components include:
-- DR-301 -- DR-558 -- DR-851 -- HT-50B
-- HT-50DC -- HT-100B -- HT-100BC -- SDI-76A
-- SDI-77C -- SD-80B -- SD-80EHB -- SD-150B
-- SD-150EHB -- SRN-2000H

**Exterior Sensors:**

The following sensors are approved for use as a standalone line of detection:
BEA LZR-s600 (ECP Configuration)
BEA LZR-i30 (ECP Configuration)
EAG of Americas Infrared Intrusion Detection System 4/2/2 (IIDS4/2/2) Active Infrared Sensor
EAG of Americas Infrared Intrusion Detection System 4/4/2/2/2 w/ PSTC
EAG of Americas Intrusion Detection System 4/2 (IDS 4/2) Active Infrared Sensor
IR Global Infrared Intrusion Detection System 4/4/2
IR Global IRG-509-15M
+ Microtrack buried line sensor *(NOTE: Not approved for use in Northern tier, or areas where snow and ice accumulations are normal, pending further testing)*
Senstar Omnitrax buried line sensor firmware version MSP v2.81 w/Field Programmable Gate Array (FPGA) v13.05
Senstar Omnitrax buried line sensor w/Firmware Version MSP v2.90 w/FPGA v13.93
Senstar Ultrawave Detection Sensor TE (W/Whiteman AFB tamper protection modification)
+ Perimitrax, Buried Cable Intrusion Detection Sensor
Protech (PIRAMID) / SDI-76-XL-MIL, PIR and Monostatic Microwave Sensor
Protech (PIRAMID) / SDI-76-XL-MIL LT (Ladder and Tower) Only
Protech Sorhea Technology G-Fence 600 Zoning (600Z) System
Protech Sorhea Technology G-Fence 600 Zoning (600Z) System culvert configuration
Protech Maxiris 3100 Active Infrared Barrier (100 meter)
+ Racon Single Stack; Barksdale Configuration - single stack, basket weave configuration with double stacked sensors at the corners
+ Racon Double Stack
+ Racon 16000-4 (Microwave) Sensor
+ Racon 14000-32 Microwave Sensor
+ Racon MPS-4100 (Microwave)
+ Racon MPS-14000-1 (Microwave)
Senstar UltraWave Microwave Detection Sensor
Senstar UltraWave Microwave Detection Sensor (Firmware 3.05)
+ Senstar Sentrax Short Ported Coaxial Cable Sensor (SPCS), large and small diameter cable, in the straight-line configuration
+ Birdeye Model IX Infrared Perimeter Detection System, up to 120m
DeTekion Defensor 100 Fence Sensor
DeTekion Defensor 100 sensor system with the GD-5000 Eliminator signal analyzer
DeTekion Vertical Taut Wire Sensor 400 (VTW-400), full fence or out-rigger configuration
ECSI Infrared Pulsed Intrusion Detection System (IPIDS), up to 80m with spring loaded mount bases and 100m with solid concrete bases
Fiber SenSys Fiber Defender +FD200/300 series. The following models have been tested:
331, 332, 341, and 342. *Note: The 331 and 332 series is with "Sensitive" Lead-in cables whereas the 341 and 342 series is with the "Insensitive" Lead-in cables. Also, the last digit (1 or 2) indicates a single channel processor or dual channel processor. Additional note: The 33x series is normally utilized for TASS applications with the 34x series being utilized for all hardwired configurations.*
Fiber Sensys Fiber Defender FD-342, v4.47
Fiber Sensys Fiber Defender FD-343, v4.47 (Culvert Configuration)

+ Fence Protection System 2-2R (FPS-2-2R)
FlexZone Fence Sensor (*NOTE: Not approved for use in Northern tier, or areas where snow and ice accumulations are normal, pending further testing)*
RBtec Ironclad Fence Sensor Double Run Configuration
+ Southwest Microwave Intrepid Micropoint. *(NOTE: Not approved for use in Northern tier, or areas where snow and ice accumulations are normal, pending further testing)*
*tier, or areas where snow and ice accumulations are normal, pending further testing)*
Southwest Microwave Intrepid Micropoint II.
Southwest (SW) Microwave 385 Monostatic Sensor, up to 100m
SW Microwave 310 Bi-static Sensor, up to 100m
Southwest Microwave 460B Active Infrared Exterior Sensor
Southwest Microwave 330 Digital Microwave System
+ Fiber Optics Intrusion Detection System (FO-IDS), Fiber Optic Sensor System (FOSS) Models 100 and 200
Fiber SenSys Fiber Defender 525 *(Note: Not approved for use in Northern tier, or areas where snow and ice accumulations are normal, pending further testing)*

**The following sensors in combination are approved for use as a line of detection with fence climber enhancement detection:**

+ Enhanced DTR-90 Vertical Taut Wire (VTW) Sensor, the DTR 90 "Y" VTW Sensor, or the VTW 400 Sensor installed at the top of the fence with any one of the following sensors installed on the fence:
Fiber SenSys Fiber Defender FD300 series. The following models have been tested: 331, 332, 341, and 342.
+ Fence Protection System 2 (FPS-2)
+ Fence Protection System 2-2R (FPS-2-2R)

**Wide Area Detection/Approach Zone Sensors:**

+ PSRS STS-350 (FLIR/ICx) Ground Based Radar used as an approach sensor out to 125 meters (crawlers) as described below: ICX application software version 2.4.41.12 Firmware version 3.4.30 dated November 2, 2007.
+ PSRS STS-350 (FLIR/ICx) with control station application software version 2.4.41.12 or when integrated with Will Burt Annunciator Version 3.2.274p, subpatch p32274.1.13.
FLIR Ranger 1 Perimeter Surveillance Radar (700 meters)
FLIR Ranger 2 Perimeter Surveillance Radar (1400 meters)
FLIR Ranger 3 Perimeter Surveillance Radar (2800 meters)
Magos SR-500 perimeter surveillance system when integrated with the Advantor Systems ASN, Version 6.2. MASS Version 2.24.10053, SR-500 Radar Version 3.64 and Radar Manager Version 1.5
SpotterRF C40D Integrated with Advantor Version 6.2 *(Note: Not approved for use in Northern tier, or areas where snow and ice accumulations are normal, pending further testing)*

**PL-3 and Below**

In addition to all of the above components, the following equipment is approved for use in the protection of PL-3 and below assets:

**Command, Control Display Equipment (CCDE):**

TASS 7.0 Annunciator (At deployed locations only)
TASS 6.0.1.A Annunciator (At deployed locations only)

**Assessment Subsystems:**

Clear Align VZ-250 LRTI 23164-600
+ Clear Align VZ-250 LRTI 23164Z1-600 (Improved Cooling)
Clear Align LRTI-w/CCTV
C907891 Complete Kit
TICC/PTH only C907892
+FLIR ThermoVision Multi-Sensor System (a.k.a. SLRTI)
T-2000 LRTI w/CCTV Complete Kit IBDSS1000-085
T-2000 LRTI w/CCTV TICC/PTH only IBDSS1000-086
T-3000 LRTI w/CCTV Complete Kit FDTA-199
T-3000 LRTI w/CCTV TICC/PTH only
+ Surveillance Thermal Imager (WSTI) Sentry I and Sentry II
FLIR DEFENDIR MS-UC 640 30/90MM CZ
+ Short Range Thermal Imager; Fixed/Mounted (SRTI F/M)
+ DiOP Thermal Imager 180/60mm Thermal Upgrade Kit (TUK)

**Interior Sensors**: No Additional

**Exterior Sensors**: No Additional

**Certified Air Force Test Sites:**
Test Area C-3, Eglin AFB FL, and Cold Weather Test Site, Grand Forks AFB, ND are approved for conducting operational tests and evaluations on all IDS equipment.

2. All equipment was determined to meet all applicable TAA/BAA/NDAA requirements at the time of approval. Manufacturers could change place of origin over time. Installation agents should verify place of origin of all components prior to installation.

3. A listing of equipment approved for use in PL-1 Nuclear applications is available in a separate letter maintained by the POC listed below.

4. This memorandum supersedes the 15 Oct 20 IDS approval memorandum. The POC is 1st Lt Joshua Scollo, AFLCMC/HBUA, joshua.scollo@us.af.mil, DSN 845-5275.

LINDA W. HAINES, NH-IV, DAF
Chief, Force Protection Division

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**08/20**

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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 | (2020) American National Standard Method for Measuring the Intelligibility of Speech Over Communication Systems (ASA 85) |

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; TIA 22-1; ERTA 1 2022) National Electrical Code |
| NFPA 72 | (2022) 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 3-601-02 | (2021) Fire Protection Systems Inspection, Testing, and Maintenance |
| UFC 4-010-06 | (2016; with Change 1, 2017) Cybersecurity |

of Facility-Related Control Systems

UNDERWRITERS LABORATORIES (UL)

| | |
|---|---|
| UL 268 | (2016; Reprint Nov 2021) 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 Feb 2022) UL Standard for Safety Protectors for Data Communications and Fire Alarm 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 | (2021) 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 2017 | (2008; Reprint Dec 2018) UL Standard for Safety General-Purpose Signaling Devices and Systems |
| UL 2034 | (2017; Reprint Apr 2022) 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 (2012) Fire Protection Equipment Directory

1.2 RELATED SECTIONS

Section 25 05 11.21 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS FIRE AND LIFE SAFETY 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 13 13 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION
Section 23 30 00 HVAC AIR DISTRIBUTION
Section 08 71 00 DOOR HARDWARE for door release and additional work related to finish hardware.
Section 07 84 00 FIRESTOPPING for additional work related to firestopping.

1.3 SUMMARY

1.3.1 Scope

a. This work includes designing and modifying the existing fire alarm and mass notification (MNS) system as described herein and on the contract drawings for the PRIDE Hangar. Include system wiring, raceways, pull boxes, terminal cabinets, 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 Section 25 05 11.21 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS FIRE AND LIFE SAFETY SYSTEMS, UFC 4-010-06 and AFGM 2019-320-02.

b. Provide equipment, materials, installation, workmanship, inspection, and testing in strict accordance with NFPA 72, except as modified herein. The system layout on the drawings show the intent of coverage and suggested locations. Final quantity, system layout, and coordination are the responsibility of the Contractor.

c. Each remote fire alarm control unit must be powered from a wiring riser specifically for that use or from a local emergency power panel located on the same floor as the remote fire alarm control unit. Where remote fire control units are provided, equipment for notification appliances may be located in the remote fire alarm control units.

d. 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. Construction (shop) drawings and calculations must be prepared by, or prepared under the immediate supervision of, the QFPE. The QFPE must

affix their professional engineering stamp with signature to the shop drawings, calculations, and material data sheets, 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.

e. Signing applicable certificates under SD-07.

## 1.4 DEFINITIONS

Wherever mentioned in this specification or on the 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 (FMCU)

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 Remote Fire Alarm and Mass Notification Control Unit

A control unit, physically remote from the fire alarm and mass notification control unit, that receives inputs from automatic and manual fire alarm devices; may supply power to detection devices and interface devices; may provide transfer of power to the notification appliances; may provide transfer of condition to relays or devices connected to the control unit; and reports to and receives signals from the fire alarm and mass notification control unit.

### 1.4.4 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.

### 1.4.5 Terminal Cabinet

A steel cabinet with locking, hinge-mounted door where terminal strips are securely mounted inside the cabinet.

### 1.4.6 Control Module and Relay Module

Terms utilized to describe emergency control function interface devices as

defined by NFPA 72.

1.4.7 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.

1.4.8 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" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval.

Shop drawings (SD-02), product data (SD-03) and calculations (SD-05) must be prepared by the fire alarm 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 registered 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-AE

Fire alarm system designer; G-AE

Supervisor; G-AE

Technician; G-AE

Installer; G-AE

Test Technician; G-AE

Fire Alarm System Site-Specific Software Acknowledgement; G-AE

SD-02 Shop Drawings

Nameplates

Instructions

Wiring Diagrams

System Layout

Notification Appliances

Initiating devices

Amplifiers

Battery Power

Voltage Drop Calculations

SD-03 Product Data

Fire Alarm and Mass Notification Control Unit (FMCU); G-AE

Local Operating Console (LOC)

Amplifiers

Tone Generators

Digitalized voice generators

Manual Stations

Smoke Detectors

Duct Smoke Detectors

Carbon monoxide detector

Addressable Interface Devices

Addressable Control Modules

Isolation Modules

Notification Appliances

Textual Display Sign Control Panel

Textual Display Signs

Batteries

Battery Chargers

Supplemental Notification Appliance Circuit Panels

Auxiliary Power Supply Panels

Surge Protective Devices

Alarm Wiring

Back Boxes and Conduit

Ceiling Bridges for Ceiling-Mounted Appliances

Terminal Cabinets

Environmental Enclosures or Guards

Document Storage Cabinet

SD-06 Test Reports

Test Procedures; G-AE

SD-07 Certificates

Verification of Compliant Installation; G-AE

Request for Government Final Test; G-AE

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G-AE

Instruction of Government Employees; G-AE

SD-11 Closeout Submittals

As-Built Drawings; G-AE

Spare Parts

1.6 SYSTEM OPERATION

Fire alarm system/mass notification system including textual display sign control panel(s), components requiring power, except for the FMCU(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, FMCU, 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".

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. Program capability via switches in a locked portion of the FMCU to bypass the automatic notification appliance circuits, fire reporting system air handler shutdown door release features. Operation of this programmed action must indicate on the FMCU display as a supervisory or trouble condition.

g. Alarm functions must override trouble or supervisory functions. Supervisory functions must override trouble functions.

h. The system must be capable of being programmed from the control unit keyboard. Programmed information must be stored in non-volatile memory.

i. The system must be capable of operating, supervising, and/or monitoring non-addressable alarm and supervisory devices.

j. There must be no limit, other than maximum system capacity, as to the number of addressable devices that may be in alarm simultaneously.

k. Where the fire alarm/mass notification system is responsible for initiating an action in another emergency control device or system, such as HVAC, the addressable fire alarm relay must be located in the vicinity of the emergency control device.

l. 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 FMCU. Indication must be by 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 FMCU.

(5) Release of doors held open by electromagnetic devices.

m. A supervisory signal must automatically initiate the following functions:

(1) Visual indication of the device operated on the FMCU. Indication must be by 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 FMCU.

n. A trouble condition must automatically initiate the following functions:

(1) Visual indication of the device operated on the FMCU. 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 FMCU.

o. Activation of a carbon monoxide alarm initiating device must automatically initiate the following functions:

(1) Visual indication of the device operated on the FMCU. Indication must be by room number, device address, and device type.

(2) Transmission of a carbon monoxide alarm signal to the fire department.

(3) Activation of all strobes and the audible carbon monoxide message throughout the building.

(4) Recording of the event electronically in the history log of the FMCU.

p. 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.

q. 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.

## 1.7 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 be compatible and operable with the existing fire alarm/mass notification system and must not impair reliability or operational functions of existing supervising station fire alarm system.

b. Equipment and devices must be compatible and operable with the existing building fire alarm/mass notification system. Equipment must not impair reliability or operational functions of the existing system.

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 the Contract Drawings. 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 FMCU and remote FMCU, 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, terminal cabinet 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 FMCU 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.

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 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.

1.9.1.13 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.

1.9.2.2 Supervisor

A NICET Level IV fire alarm technician must supervise the installation of the fire alarm/mass notification system. A fire alarm technician with a minimum of eight years of experience must supervise the installation of the fire alarm/mass notification 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 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.

1.9.2.4 Installer

NICET Level II technician to 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. The fire alarm installer must be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.9.2.5 Test Technician

Fire alarm technicians with a minimum of eight years of experience and NICET Level IV 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. One electromagnetic door holders.

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. FMCU

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 Installation Fire Department.

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 FMCU. 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 (FMCU) 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 FMCU 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 semi-recessed 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 FMCU 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 FMCU 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 three 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 four-pulse temporal pattern for three cycles followed by a voice message that is repeated until the control unit is reset or silenced. Automatic messages must be broadcast through speakers throughout the building/facility but not in stairs or elevator cabs. 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 selectable by zone, or all call. The system must be capable of operating all speakers at the same time.

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 FMCU. 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 or PA microphone 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 that all other messages (except any "test" messages) and must not override any other messages.

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 1000 Hz tone (as required by NFPA 72) must precede messages and be similar to the existing mass notification messages within the PRIDE Hangar.

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.

2.3.5 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 FMCU 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 FMCU.

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 FMCU 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 FMCU. The housing for the LOC must not be lockable.

2.4.2 Multiple LOCs

When an installation has more than one LOC, the LOCs must be programmed to allow only one LOC to be available for paging or messaging at a time. Once one LOC becomes active, all other LOC's will have an indication that the system is busy (Amber Busy Light) and cannot be used at that time. This is to avoid two messages being given at the same time. It must be possible to override or lockout the LOC's from the FMCU.

## 2.5 AMPLIFIERS, PREAMPLIFIERS, TONE GENERATORS

Any amplifiers, preamplifiers, tone generators, digitalized voice generators, and other hardware necessary for a complete, operational, textual audible circuit conforming to NFPA 72 must be housed in a remote FMCU, terminal cabinet, or in the FMCU. 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 Inputs

Equip each system with separate inputs for the tone generator, digitalized voice driver and control unit mounted microphone. Microphone inputs must be of the low impedance, balanced line type. Both microphone and tone generator input must be operational on any amplifier.

### 2.5.4 Tone Generator

The tone generator must produce a three-pulse temporal pattern and must be constantly repeated until interrupted by either the digitalized voice message, the microphone input, or the alarm silence mode as specified. The tone generator must be single channel with an automatic backup generator per channel such that failure of the primary tone generator causes the backup generator to automatically take over the functions of the failed unit and also causes transfer of the common trouble relay. The tone generator must be provided with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces.

### 2.5.5 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 illumination of a visual "amplifier trouble" indicator on the control unit, appropriate logging of the condition in the history log, and other actions for trouble conditions as specified.

## 2.6 MANUAL STATIONS

Provide metal or plastic, semi-flush or surface 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.

## 2.7 SMOKE DETECTORS

### 2.7.1 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 FMCU.

b. Provide self-restoring type detectors that do not require any readjustment after actuation at the FMCU 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. Detectors must be of the low voltage type rated for use on a 24 VDC system.

f. Laser smoke detector must provide point identification of the fire location through addressability, must experience no delay in response time due to smoke dilution or smoke transportation time, and must offer complete supervision of wiring and detector.

### 2.7.2 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 FMCU.

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 FMCU.

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 specified in Section

23 09 00 to INSTRUMENTATION AND CONTROL FOR HVAC. 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.

2.8 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 FMCU with no listed compatible addressable CO detectors, provide listed 4-wire detectors. Do not provide CO detectors with local alarms. 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 FMCU.

d. Detectors must be provided with a means to test CO gas entry into the CO sensing cell.

2.9 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.

2.10 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 door holders or initiate elevator fire service. 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.

## 2.11 ISOLATION MODULES

a. Provide isolation modules to subdivide each signaling line circuit in accordance with NFPA 72 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 FMCU.

d. After the wiring fault is repaired, the fault isolation modules must test the lines and automatically restore the connection.

## 2.12 NOTIFICATION APPLIANCES

### 2.12.1 Audible Notification Appliances

Audible appliances must conform to the applicable requirements of UL 464. Appliances must be connected into notification appliance circuits. Surface mounted audible appliances must be painted white. Recessed audible appliances must be installed with a grill that is painted white.

#### 2.12.1.1 Speakers

a. Speakers must conform to the applicable requirements of UL 1480. Speakers must have six 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 FMCU.

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.

### 2.12.2 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 a minimum of 15 30 75 177 candela based on the UL 1971 test. Strobe must be surface or semi-flush mounted.

2.12.3 Textual Display Signs

Textual display signs must be of the same type as those existing in the facility and must not exceed 16 inches long by 6 inches high by 3 inches deep with a height necessary to meet the requirements of NFPA 72. The text display must spell out the word "EVACUATE" or "ANNOUNCEMENT" as appropriate. The design of text display must be such that it cannot be read when not illuminated.

LCD or LED scrolling text displays must meet the following requirements at a minimum:

a. Two lines of information for high priority messaging.

b. Minimum of 20 characters per line (40 total) displayed.

c. Text must be no less than height requirements and color/contrast requirements of NFPA 72.

d. 32K character memory.

e. Display must be wall or ceiling mounted.

f. Mounting brackets for a convenient wall/cubicle mount.

g. The system must interface with the textual display sign control panel to activate the proper message.

2.13 ELECTRIC POWER

2.13.1 Primary Power

Power must be 120 VAC 60 Hz service for the FMCU from the AC service to the building in accordance with NFPA 72.

2.14 SECONDARY POWER SUPPLY

Provide 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.

2.14.1 Batteries

Provide sealed, maintenance-free, sealed lead acid batteries as the source for emergency power to the FMCU. 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.

2.14.1.1 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.

2.14.1.2 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.

2.14.2 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.

2.15 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 FMCU 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.

## 2.16 WIRING

Provide wiring materials under this section as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM with the additions and modifications specified herein.

### 2.16.1 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 No. 18 AWG size conductors at a

minimum. Visual notification appliance circuit conductors, that contain audible alarm appliances, must be copper No. 16 AWG size conductors at a minimum. Speaker circuits must be copper No. 16 AWG size 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 FMCU. 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 red colored covering. Nonpower-limited cables must comply with NFPA 70.

## 2.17 SYSTEM MONITORING

### 2.17.1 Valves

Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, sprinkler service entrance valve, 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, unless they are within the same room, then a maximum of five can use the same address.

## 2.18 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 (FMCU)

Locate the FMCU where indicated on the drawings. Semi-recess the enclosure with the top of the cabinet 6 feet above the finished floor or center the cabinet at 5 feet, whichever is lower. Conductor terminations must be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection must be permanently mounted in the FMCU. Locate the document storage cabinet adjacent to the FMCU unless the Contracting Officer directs otherwise.

3.2.2 Battery Cabinets

When batteries will not fit in the FMCU, locate battery cabinets below or adjacent to the FMCU. 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 required by NFPA 72 and as indicated on the drawings. Mount stations so they are located no farther than 5 feet from the exit door they serve, measured horizontally. Manual stations must be mounted at 44 inches measured to the operating handle.

3.2.4 Notification Appliances

a. Locate notification appliance devices as required by NFPA 72 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 FMCU or LOC so as to cause feedback when the microphone is in use.

3.2.5 Smoke and Heat Detectors

Locate detectors as required by NFPA 72 and their listing on a 4-inch mounting box. Install heat detectors not less than 4 inches from a side wall to the near edge. Heat detectors located on the wall must have the top of the detector at least 4 inches below the ceiling, but not more than 12 inches below the ceiling. Smoke detectors are permitted to be on the wall no lower than 12 inches from the ceiling with no minimum distance from the ceiling.

3.2.6 Carbon Monoxide Detectors

Locate detectors as required by NFPA 72 and their listings on a 4-inch mounting box. Carbon monoxide detectors must be installed separate from smoke and/or heat detectors.

3.2.7 Electromagnetic Door Holder Release

Doors must be held open at a minimum of 90 degrees so as not to impede egress from the space. Mount the armature portion on the door and have an adjusting screw for seating the angle of the contact plate. Wall-mount the electromagnetic release, with a total horizontal projection not exceeding 4 inches. Ensure all doors release to close upon first stage (pre-discharge) alarm. Electrical supervision of wiring external of control unit for magnetic door holding circuits is not required.

3.2.8 Local Operating Console (LOC)

Locate the LOC(s) as required by NFPA 72 and as indicated. Mount the console so that the top message button and microphone is no higher than 4 feet above the floor and the bottom (lowest) message button and microphone is at least 3 feet above the finished floor.

3.2.9 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 that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box must be connected to screw-type terminal blocks. 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 FMCU 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 Terminal Cabinets

Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Terminal size must be appropriate for the size of the wiring to be connected. Conductor terminations must be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection must be permanently mounted in the terminal cabinet. Minimum size is 8 inches by 8 inches. Only screw-type terminals are permitted. Provide an identification label,

that displays "FIRE ALARM TERMINAL CABINET" with 2-inch lettering, on the front of the terminal cabinet.

3.3.3 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 FMCU.

c. Pigtail or T-tap connections to signal line circuits, initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for Class "B" signaling line circuits.

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.

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).

3.3.4 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 prohibited for notification appliance circuits and 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.

3.3.5 Conductor Terminations

Labeling of conductors at terminal blocks in terminal cabinets, FMCU, and remote FMCU 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 terminal cabinet, FMCU, and remote FMCU 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. Maintain existing color code scheme where connecting to existing equipment.

3.4 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.

3.5 PAINTING

a. In unfinished areas (including areas above drop ceilings), paint all exposed electrical conduit (serving fire alarm equipment), fire alarm conduit, surface metal raceway, junction boxes and covers red. In lieu of painting conduit, the contractor may utilize red conduit with a factory applied finish.

b. 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" and the conduit must have painted red bands 3/4-inch wide at 10-foot centers and at each side of a floor, wall, or ceiling penetration.

c. 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 NICET Level IV Fire Alarm 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 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, special hazard equipment, emergency communication equipment, 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 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 Contracting Officer's Representative (COR), 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 control unit 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 FMCU. 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 real smoke or the use of canned smoke which is permitted.

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 is provided in each area where building occupants typically could be found. The minimum required value for CIS is .8. 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 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 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 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 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.

#### 3.9.2.1 Technical Training

Equipment manufacturer or a factory representative must provide 1 days of on site. Training must allow for classroom instruction as well as individual hands on programming, troubleshooting and diagnostics exercises.

### 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 manufacturer. 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 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 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 --

# Justification and Approval (J&A) *for* Other Than Full and Open Competition

**Was a J&A approved for the preceding acquisition?** ☐ Yes ☒ No

**Is this a new or amended J&A Document?** ☒ New ☐ Amended ( *Prior to Award Only!* )

**Is this a Bridge Action as defined at AFFARS 5302.101?** ☐ Yes ☒ No

**Dollar Value of this Acquisition:** ☐ ≤ $750K ☒ > $750K and ≤ $15M ☐ > $15M and ≤ $100M ☐ > $100M

**Contracting Activity:** Air Force Installation Contracting Center (AFICC)

**Purchase Request (if available):** TBD

**Program / Project** (and PE, if applicable)**:** Facility Fire Alarm Replacement Standardization

**Program Type** (PEO, Enterprise, of Operational)**:** Operational

**Authority:** 6.302-1 – 10 USC 2304(c)(1), Only One Responsible Source and No Other Supplies or Services Will Satisfy Agency Requirements

**Estimated Contract Cost** (including options)**:** $ 14,800,000 J&A Type: ☒ Class ☐ Individual

!! Provide estimated cost of all contracts.

## COORDINATION ( AFFARS 5306.304(a))

| Date | | Signature |
|---|---|---|
| 22 Sep 2021 | Project Lead / Program Mgr / Requiring Activity<br>Major Patrick J. Grandsaert<br>AFCEC/COOM / DSN 523-6931 | GRANDSAERT.PATRICK.JOSEPH.1283426889<br>Digitally signed by GRANDSAERT.PATRICK.JOSEPH.1283426889<br>Date: 2021.09.22 21:55:55 -05'00' |
| Date | | Signature |
| 04 Oct 2021 | Contracting Officer<br>Major Anthony S. Percy<br>AFICC 772 ESS/PKD / DSN 523-6482 | PERCY.ANTHONY.S.1011007097<br>Digitally signed by PERCY.ANTHONY.S.1011007097<br>Date: 2021.10.04 13:47:04 -05'00' |
| Date | | Signature |
| 12 Oct 2021 | Local Legal Reviewer<br>Ms. Karen White<br>AFIMSC/JAQ / DSN 523-6575 | WHITE.KAREN.SUE.1157422550<br>Digitally signed by WHITE.KAREN.SUE.1157422550<br>Date: 2021.10.12 10:09:47 -05'00' |
| Date | | Signature |
| 19 Oct 2021 | Chief of the Contracting Office (COCO)<br>Lt Col Michael E. Corrigan<br>772 ESS/CC / DSN 969-8776 | CORRIGAN.MICHAEL.E.1084070757<br>Digitally signed by CORRIGAN.MICHAEL.E.1084070757<br>Date: 2021.10.19 09:57:30 -05'00' |
| Date | | Signature |
| 29 Nov 2021 | Director, Acquisition Support (AFICC/KP)<br>Robert A. Hixenbaugh/DSN 787-5529 | HIXENBAUGH.ROBERT.ALLEN.1080487998<br>Digitally signed by HIXENBAUGH.ROBERT.ALLEN.1080487998<br>Date: 2021.11.29 15:26:42 -05'00' |
| Date | | Signature |
| 30 Nov 2021 | Director, Enterprise Solutions Support (AFICC/KA)<br>Roger H. Westermeyer/DSN 787-5217 | WESTERMEYER.ROGER.H.1102036324<br>Digitally signed by WESTERMEYER.ROGER.H.1102036324<br>Date: 2021.11.30 14:47:52 -05'00' |
| Date | | Signature |
| | | |

## Justification and Approval (J&A) *for* Other Than Full and Open Competition

**APPROVAL** ( **AFFARS 5306.304(a)**)

| Date | Competition Advocate | Signature |
|---|---|---|
| 17 Dec 2021 | Mr. Anthony W. Everidge, SES<br>AFICC/CA / DSN 787-1900 | EVERIDGE.ANTHONY.W.1230167814<br>Digitally signed by EVERIDGE.ANTHONY.W.1230167814<br>Date: 2021.12.17 12:14:16 -05'00' |

## Justification and Approval (J&A) *for* Other Than Full and Open Competition

**I. Agency and Contracting Activity.**

Department of the Air Force, Air Force Installation Contracting Center, 772 Enterprise Sourcing Squadron, Bldg 1, Port San Antonio, 3515 S. General McMullen, Ste 200, San Antonio, TX 78226-1865.

**II. Nature and/or description of the action being approved.**

The United States Air Force (USAF) has a brand name requirement to procure facility fire alarm panels from a limited selection of manufacturers specified by location to support new fire alarm panel purchases for the remainder of this Fiscal Year (FY) through 30 Sep 2026. This Class J&A will support multiple contracts (new) throughout CONUS and OCONUS locations.

**III. Description of supplies/services required to meet agency needs (including the estimated value).**

This Class J&A covers all USAF facility fire alarm panel purchases from the effective date of this Class J&A through 30 Sep 2026. Fire alarm panel purchases during the next 5 years are expected to number 20864 units (the number of units expected to reach the end of service life). The total spend necessary for replacement of these units has been estimated at approximately $14.8M. Approval of this Class J&A will reduce the total cost of ownership to the Air Force by eliminating inefficiencies and duplication in cost by reducing the need to train USAF fire alarm panel technicians on multiple manufacturers' systems, eventually reducing training requirement by an estimated $22M and 375K hours per 5 year training cycle. Standardization under this class J&A also allows, over time, fire alarm panel repair and programming to be done in-house as the primary option versus contracting out these services. Approval will also increase mission performance efficiencies by streamlining and specializing Civil Engineering (CE) maintainer's schoolhouse training and more importantly additional training at the maintainer's duty location on base-specific manufactures' generators, increasing expertise of organic technicians thereby reducing downtime of fire alarm panels for repair and replacement due to increasing expertise of organic technicians. The increased availability of trained technicians also improves the sustainment of the Air Force's equipment, machinery, and communications systems. Approval will also increase process efficiencies by allowing CE pre-planning for building design, will improve life-cycle maintenance and replacement of expensive and critical equipment, and will leverage spending on spare parts inventory.

**IV. Statutory authority permitting other than full and open competition.**

The Competition in Contracting Act (CICA) at 10 U.S.C. 2304(c)(1), as implemented by FAR 6.302-1(a)(2) and required by FAR 6.303-2(b)(4), states when supplies or services required by the agency are available from a limited number of responsible sources and no other type of supplies or services will satisfy agency requirements, full and open competition need not be provided for.

**V. Demonstration that the contractor's unique qualifications or the nature of the acquisition requires use of the authority cited above (applicability of authority).**

The Air Force is required to use the “brand name exception” to CICA because the nature of the acquisition as a strategic vehicle for Category Management (CM) requires a pre-planned brand name approach to acquiring facility fire alarm panels. This brand name acquisition is integral to avoiding estimated costs in training expenses and efficiency improvements in mission performance not otherwise available under full and open competition.

The training requirements of Air Force maintenance personnel would be greatly reduced under the standardization of fire alarm panels as described in paragraph II. There are two aspects of training for Air Force maintenance personnel. Similar to other Air Force assets, additional training beyond initial skills training is required to maintain proficiency in the system's maintenance. Initial training for Air Force personnel maintaining fire alarm panels is conducted at Sheppard AFB (the “school house”) and includes basic instruction for common maintenance and operations across the inventory of Air Force fire alarm panels. However, there is no detailed instruction on fault diagnosis and repair because the Air Force inventory of fire alarm panels has 28 different manufacturers, the unique difference in the manufacturers' processes cannot be trained to ensure trainees master all manufacturers at initial skills training. Therefore Air Force personnel require additional training at the maintainer's duty location on base-specific manufactures' fire alarm panels. At every Air Force base, there are between 1 and 15 unique manufactures' fire alarm panels requiring the local training to stretch across all different types of fire alarm panels The Air Force Civil Engineering Center (AFCEC) Force Development Manager for electricians reviewed the Career Field Education and Training Plan (CFETP) to capture the costs for minimal training to operate and maintain multiple

systems. Of the 16 fire alarm panel related tasks on the CFETP, 16 tasks would have to be re-learned or accomplished with each new manufacturer bought and installed. Thus, 100% of the advanced fire alarm panel training costs is repeated at the duty station for each new manufacturer installed at a base. This level of effort is not practical, and cannot occur while still meeting the basic mission needs. The result is an under-trained workforce burdened to train-as-you go, which ends in failed attempts to maintain and repair critical infrastructure equipment.

Additional training must also be provided to ensure advanced troubleshooting and repair of specific systems. Advanced training requires the manufacturer to be involved in order to certify that the maintainer can use proprietary systems for fault diagnosis, program fire alarms, or have access to proprietary code for digital faults. The cost of this training is high and is specific to each manufacturer. Currently, the Air Force funds this training for only the top manufacturer used at the base, on a case by case basis, and any repairs required on other complex systems are contracted out.

The training is currently conducted by the manufacturers at their location resulting in Temporary Duty (TDY) costs for all technicians requiring training. Each manufacturer has different courses that must all be completed to be fully trained. The majority of installations, 86%, have more than one fire alarm panels manufacturer represented, with a mean value of 7.13, and a maximum of 15. This represents a significant duplication of training costs and time in having technicians obtain required training from each manufacturer.

Manufacturer-specific training for CFETP requirements for fire alarm panels has been priced from actual expenses for OEM systems. The total cost to train one technician on one of the three main OEM fire alarm panels in the Air Force ranges from $8400 to $9300 per person, or an average cost of $8,566. If we take the 381 technicians, assume 33% need training annually due to turn over, apply the average cost to 126 technicians to 7.13 brands, consolidating to up to 3 brands would reduce our training requirements by $22M over a 5 year period. These TDYs also take 144 duty hours away from the mission, thus, using the same calculation, consolidating to up to 3 brands would return 375K hours to the mission.

The biggest requirement reductions would result by the Air Force establishing local specialized training, once the installation's standardized fire alarm panel manufacturer is designated. However, even if the Air Force paid full vendor prices and were trained at the bases instead of sending technicians TDY, any mix of training reform aided by standardization results in millions in cost requirement reductions.

The Category Management process identified the Air Force did not have an established TCO model for real property installed equipment. The CIR team sponsored a master's student at the Air Force Institute of Technology (AFIT) to develop a Total Cost of Ownership (TCO) model template for RPIE systems that includes sustainment costs. A major finding of this thesis is the enterprise lacks data to properly complete a TCO model. Therefore, the model was used for this effort was derived from existing operations and maintenance and contract spending data associated with fire alarm panels. The TCO model provides USAF acquisition, contracting, and civil engineering professionals a tool with which to project life-cycle costs, negotiate prices, and justify spending decisions. Furthermore, the model provides a proof of concept to the CE enterprise that will allow for the expansion of TCO modeling to other categories of spending.

Implementation of this Class J&A will (1) standardize the USAF on a limited number of facility fire alarm panel manufacturers which reduces training requirements by an estimated $22M and training hours by 375K per 5 year training cycle, (2) will ensure training will be more defined, (3) will increase the responsiveness and effectiveness of in-house technicians resulting in fewer and shorter downtimes for facility fire alarm panels, (4) will lead to a more cost effective delivery of mission capability by ensuring Air Force technicians are fully trained, and (5) reduce cyber security requirements across the CE enterprise. Therefore, award to any other sources than those specified brand names for specified Air Force bases would result in continued substantial duplication of cost and lowered mission performance to the Government that is not expected to be recovered through competition. Finally, approval will generate demand efficiencies by reducing the equipment and parts inventories for CE and the personnel required to sustain them.

**VI. Description of efforts made to ensure that offers are solicited from as many potential sources as practicable, including whether a notice was or will be publicized as required by subpart 5.2 and, if not, which exception under FAR 5.202 applies.**

IAW FAR 5.201 a Notice of Proposed Contract Action/Special Notice, 772_Fire_Alarm_Panel_Brand_Namewas posted on SAM.gov (Government Point of Entry "GPE") 01 June 2021; the posting remained open for 15 days.

A brief description of the requirement was included in the GPE notice. The notice advised that any interested responsible party that believed it was equally or otherwise uniquely capable of meeting the requirements should submit a capability statement. The notice also stated that supporting evidence must be furnished in sufficient detail to not only demonstrate the ability to fulfill the requirement but also demonstrate that competition would be advantageous to the government and would not create a break in service or degradation of performance quality. Zero vendors expressed interest in the published Special Notice/Synopsis that was posted on the GPE.

In addition, a survey of small business companies from GSA listings was conducted in March 2021. A minimum of 17 GSA defined small business in different zones across the United States were found to be capable of performing fire alarm panel removal and install. This list of small business supports the idea of competition among the manufacturers being maintained at the distributor level, where possible small business awards can be made. The cost and efficiency benefits to the Air Force through standardization and interoperability, with sunk costs of existing and highly reliable infrastructure, greatly outweighs the expected benefits of competition of differing OEM brands.

Ultimately, full and open competition is what led the Air Force to the current state of costly training but still less than fully trained technicians, multiple systems per base requiring contracting out advanced repairs, and preventing the efficiencies of less system down-time. The Air Force owns and operates large infrastructure systems, however installing disparate systems has led to a lack of operations and maintenance proficiency. The market research and the subject matter expert analysis captured in the CIR documents that training effectiveness and system knowledge diminish as manufacturer diversity increased. Inversely, costs to train go up to pay for diverse training programs over all the systems. Lack of expertise with complexity across multiple fire alarm panel systems coming from a multitude of vendors all lead to gaps in training, and inability to operate and maintain systems effectively. Finally, the CE schoolhouse training dollars as well as local base O&M funds for training are not being effectively applied when the result is less than a fully qualified organic maintenance function. The efficiencies gained by standardization on selected brand name systems per base will allow the unspent O&M funds to be applied to unmet training needs.

## VII. Determination by the Contracting Officer that the anticipated cost to the Government will be fair and reasonable.

Contracting Activities will be required to make an individual determination of price fair and reasonableness IAW FAR 13.106-3(a) (simplified acquisitions) or FAR 15.403-3(c)(1) (commercial acquisitions) prior to award. AFCEC and local bases have a large data base of historical prices based on competitive acquisitions, which should be used for comparisons and the government's estimate. While there would not be competition among manufacturers for a local base buy of the assigned name brand fire alarm panel under this J&A, there can still be competition between distributors and most decentralized purchases will include installation and minimal training when needed. These costs will be competed, most likely among small business installers.

At this time, the Air Force CE community needs the immediate J&A authority to limit acquisitions to assigned brand name fire alarm panels because it is estimated that approximately $14.8M of the estimated $126M in fire alarm panels have either reached their end of life or will reach their end of service life over the next five years. Procuring under this class J&A will replace the anticipated repeated requests from local contracting units for brand name J&As to ensure equipment interoperability which were not consistently processed and approved and often stalled procurements by roughly 12 weeks on average for similar RPIE requirements. Under this class J&A, contracting units will not process separate J&As, creating more agile acquisition cycles, as well as cost avoidance in demand and process.

## VIII. Description of the market research conducted and the results, or a statement of the reasons market research was not conducted.

A joint CIR between Air Force Installation and Mission Support (AFIMSC), AFCEC, and AFICC was accomplished in 2018 to gain practical knowledge and experience in how the Air Force manages RPIE. Supporting facts in this Class J&A were drawn from this CIR and current BUILDER inventory data. Fire alarm panel specific input was gathered from AFCEC and base level subject-matter experts and market analysis. Additionally, IAW FAR 5.201 a Notice of Proposed Contract Action/Special Notice, 772_Fire_Alarm_Panel_Brand_Namewas posted on SAM.gov (Government Point of Entry "GPE") 01 June 2021; the posting remained open for 15 days. Zero vendors expressed interest or concerns in the published Special Notice/Synopsis that was posted on the GPE.

## Justification and Approval (J&A) *for* Other Than Full and Open Competition

**IX. Any other facts supporting the use of Other Than Full and Open Competition.**

In order to increase mission performance, requirement reductions, and innovation in business methods, facility fire alarm panels standardization supports the National Defense Strategy objective to innovate business decisions for saving taxpayer dollars. In order to implement this acquisition strategy, the Air Force must pre-plan the brand name facility fire alarm panels per installation.

**X. List of any sources that expressed, in writing, an interest in the acquisition.**

This class J&A does not have a specific acquisition attached to this request. No sources that expressed interest in this effort. The underlying analysis of the need for standardization accounted for as many different manufacturer's brands as would be practical to achieve the maximum amount of requirement reduction and efficiencies. An “or equal” manufacturer to those specified by location is an oxymoron in that other brands may be able to generate fire alarm codes and alerts equally. However, those “or equals” could not produce the requirement reductions and efficiencies determined by the extensive business analysis found in the CIR because they could not provide the standardized training on proprietary information and designs, and could change the fact that multiple manufacturers would still be procured using the status quo procedures. The efficiencies of maintaining a limited number of fire alarm panel brands over time could not be achieved.

**XI. A statement of the actions, if any, the agency may take to remove or overcome any barriers to competition before making subsequent acquisitions for the supplies or services required.**

The only barriers to competition under this class J&A have been generated by historical purchases. This class J&A action only recognizes that past competitive awards have established the number and mix of fire alarm panels on each base. The Category Management analysis and action only recognizes these facts and maximizes efficiencies based on what the Air Force has in its current inventory across the enterprise and at local levels. The Air Force will continue to perform data driven analysis over time to look for market changes that may increase competition amongst fire alarm panel manufacturers. Additionally, as standard industry practice involves manufacturers, selling through vendors, competition will be maintained at the Dealer/ Distributor level. As noted earlier, the Air Force may pursue negotiations for best customer pricing directly with selected brand name manufacturers to pre-price the fire alarm panels

**XII. Certification by the Contracting Officer.**

As evidenced by my signature above, I have determined this document to be both accurate and complete to the best of my knowledge and belief.

**XIII. Certification by the technical/requirements personnel.**

As evidenced by my (our) signature(s) above, I (we) certify that any supporting data contained herein, which is my (our) responsibility, is both accurate and complete.

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SECTION 31 00 00

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SECTION 31 00 00

EARTHWORK
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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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| 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 WATER WORKS ASSOCIATION (AWWA)

| | |
|---|---|
| AWWA C600 | (2017) Installation of Ductile-Iron Mains and Their Appurtenances |

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 |
| ASTM C33/C33M | (2018) Standard Specification for Concrete Aggregates |
| 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 C136/C136M | (2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates |
| ASTM C150/C150M | (2022) Standard Specification for Portland Cement |
| ASTM C260/C260M | (2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete |
| ASTM C494/C494M | (2019; E 2022) Standard Specification for Chemical Admixtures for Concrete |

| | |
|---|---|
| ASTM C685/C685M | (2017) Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing |
| ASTM C940 | (2016) Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory |
| 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-µm (No. 200) Sieve in Soils by Washing |
| ASTM D1248 | (2016) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable |
| 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 D1883 | (2016) Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils |
| ASTM D2435/D2435M | ( 2011) Standard Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading |
| 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 D4253 | (2016; E 2019) Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table |
| ASTM D4546 | (2021) Standard Test Methods for One-Dimensional Swell or Collapse of Soils |
| ASTM D4718/D4718M | (2015) Standard Practice for Correction of Unit Weight and Water Content for Soils |

| | |
|---|---|
| | Containing Oversize Particles |
| ASTM D4832 | (2016; E 2018) Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders |
| 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 |

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

| | |
|---|---|
| EPA 600/4-79/020 | (1983) Methods for Chemical Analysis of Water and Wastes |
| EPA SW-846.3-3 | (1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods |

## 1.2 DEFINITIONS

### 1.2.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SM, SW-SM, SC, SW-SC, CL, CH. Satisfactory materials for grading comprise stones less than 6 inches, except for fill material which comprise stones less than 3 inches in any dimension.

### 1.2.2 Engineered Fill

On-site sources of engineered fill were not identified. These materials will have to be imported to the site. All engineered fill materials must consist of non-expansive, well-graded natural or crushed gravel with 100 percent passing the 3-inch sieve and between 8 percent and 20 percent passing the #200 sieve. The engineered fill material must also have a liquid limit less than 30 and a plasticity index of less than 15.

### 1.2.3 Imported Non-Engineered Fill

Non-structural, general site fill areas must have a maximum particle size of 3 inches and meet one of the following USCS classifications: GM, GC, SM, SC, CL. The imported fill material must have a free swell of less than 1.0 percent as determined by ASTM D4546 or ASTM D2435/D2435M.

### 1.2.4 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.2.5 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 and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D4318, ASTM C136/C136M and ASTM D1140.

1.2.6 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum 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, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with AASHTO T 180 and corrected with ASTM D4718/D4718M. To maintain the same percentage of coarse material, use the "remove and replace" procedure as described in NOTE 8 of Paragraph 7.2 in AASHTO T 180.

1.2.7 Topsoil

Material suitable for topsoils obtained from offsite areas or excavations is defined as: 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. Depth of topsoil must be at least 4 inches. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.2.8 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.2.9 Select Granular Material

1.2.9.1 General Requirements

Select granular material consist of materials classified as GW, GP, by ASTM D2487 where indicated. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D4318, and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D1140.

1.2.9.2 California Bearing Ratio Values

Bearing Ratio: At 0.1 inch penetration, provide a bearing ratio of 30 percent at 95 percent ASTM D1557 maximum density as determined in accordance with ASTM D1883 for a laboratory soaking period of not less than 4 days.

1.2.10 Initial Backfill Material

Utility trench excavations at the site will generally encounter lean to fat clay and sandy gravel soils. The on-site soils excavated from

trenches are suitable, in general, for use as trench backfill. Utility trench backfill soils must be free of vegetation, debris, and other deleterious materials. Within 25 feet of structures utility trench backfill soils must consist of select, on-site lean to fat clay soils only (USCS Classification CL or CH). The utility trench backfill soils in these areas should be observed and approved by the Geotechnical Engineer prior to placement. Utility trench check dams consisting of lean to fat clay soils must be constructed within 15 of building limits for utilities entering building footprints.

Initial backfill consists of select granular material or satisfactory materials free from rocks 1 inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, free the initial backfill material of stones larger than 1 inches in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

1.2.11 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 18 when tested in accordance with ASTM D4318.

1.2.12 Nonfrost Susceptible (NFS) Material

Nonfrost susceptible material are a uniformly graded washed sand with a maximum particle size of 3 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

1.2.13 Stabilization Rock

On-site sources of stabilization rock were not identified. These materials will have to be imported to the site, if necessary. The stabilization rock shall be a clean rock with 100 percent passing the 3-inch sieve, 0 to 15 percent passing the 1-inch sieve, and 0 to 8 percent passing the #4 sieve.

1.2.14 Controlled Low Strength Materials (CLSM) - Flowable Fill

Flowable fill used on this project shall be limited to excavations below existing utilities with limited access for compaction equipment and for overexcavation/undercutting of existing pavements. Contractor to obtain approval from the Contracting Officer prior to use on the project site.

a. Flowable fill refers to a cementitious slurry consisting of a mixture of fine aggregate or filler, water, and cementitious material(s), which is used as a fill or backfill in lieu of compacted earth. This mixture is capable of filling all voids in irregular excavations and hard to reach places, is self-leveling, and hardens in a matter of a few hours without the need for compaction in layers. Flowable fill is sometimes referred to as controlled density fill (CDF), controlled low strength material (CLSM), lean concrete slurry, and unshrinkable fill.

b. Flowable fill materials shall be used only as a structural fill should existing pavements become undermined during trenching activities, and as approved by the Contracting Officer. Unless otherwise noted, flowable fill installed as a substitution for structural earth fill, shall not be designed to be removed by the use of hand tools. The materials and mix design for the flowable fill should be designed to

produce a comparable compressive strength to the surrounding soil after hardening, making excavation at a later time possible to produce the compressive strength indicated for the placed location.

c. Flowable fill shall be manufactured by a ready-mix concrete producer with a minimum of 1-year of experience in the production of similar products.

d. Materials:

(1) For each type of material required for the work of this Section, provide primary materials that are the products of one manufacturer.

(2) If not otherwise specified here, materials shall comply with recommendations of ACI 299 "Controlled Low Strength Materials."

1.2.14.1 Pre-Approval Procedures

During the submittal process, the Contractor shall prepare and submit various flowable fill mix designs. Approval for the strength of the flowable fill shall be obtained from the Contracting Officer. Prior to commencement of field operations, the Contractor shall establish procedures to maintain optimum working conditions and to coordinate the work with related and adjacent work.

1.3 SYSTEM DESCRIPTION

Subsurface soil boring logs are shown on the drawings. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.3.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.3.1.1 Common Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

1.3.2 Blasting

Blasting will not be permitted.

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

Controlled Low Strength Materials (CLSM) - Flowable Fill

Shoring

SD-03 Product Data

Utilization of Excavated Materials

Detection Wire

Warning Tape

SD-06 Test Reports

Testing

Borrow Site Testing

Within 24 hours of conclusion of physical tests, submit 3 copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing

## PART 2 PRODUCTS

### 2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for Total Petroleum Hydrocarbons (TPH), Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and full Toxicity Characteristic Leaching Procedure (TCLP) including ignitability, corrosivity and reactivity. Backfill shall contain a maximum of 100 parts per million (ppm) of total petroleum hydrocarbons (TPH) and a maximum of 10 ppm of the sum of Benzene, Toluene, Ethyl Benzene, and Xylene (BTEX) and shall pass the TCPL test. Determine TPH concentrations by using EPA 600/4-79/020 Method 418.1. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5030/8020. Perform TCLP in accordance with EPA SW-846.3-3 Method 1311. Provide Borrow Site Testing for TPH, BTEX and TCLP from a composite sample of material from the borrow site, with at least one test from each borrow site. Do not bring material onsite until tests have been approved by the Contracting Officer.

### 2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches 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. Provide permanent color and printing, unaffected by moisture or soil.

| Warning Tape Color Codes | |
|---|---|
| Red | Electric |

| Warning Tape Color Codes | |
|---|---|
| Yellow | Gas, Oil; Dangerous Materials |
| Orange | Telephone and Other Communications |
| Blue | Water Systems |
| Green | Sewer Systems |
| White | Steam Systems |
| Gray | Compressed Air |

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004 inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape 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.

2.3 DETECTION WIRE FOR UTILITY PIPING (TRACER WIRE)

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG per ASTM B3 or ASTM B8 on all buried piping for water, firewater, sanitary, industrial waste, and gas systems..

a. Conductor: 12 AWG solid strand soft drawn copper per ASTM B3 or ASTM B8. The breaking pounds of the wire shall be a minimum of 124 with an O.D. of 0.154. All wire shall be spark tested at 7500 VAC.

b. Insulation: Conductor shall be insulated with low density high molecular weight polyethylene insulation suitable for direct bury applications per ASTM D1248. The minimum insulation thickness shall be 0.045. The color of the insulation shall be blue with a print line saying "WATER" for water and firewater, green with the print line saying "SEWER", yellow with the print line saying "GAS", or brown with the print line saying "INDUSTRIAL".

c. Splices and or Connectors: Splices and/or Connectors should be capable of handling from 2 to 4 wires per connector and designated as "waterproof". PVC adhesives or sealing compounds are not acceptable.

d. Tracer Wire Access Box: Tracer wires shall be terminated using a small terminal box suitable for flush burial with a 2-1/2 inches

lockable cast iron top, integral stainless terminals and a minimum 12 in. ABS bottom section.

e. Tracer wire shall be installed with short pieces of polypipe spanning across all joints to protect the tracer wire.

2.4 VAPOR BARRIER

Provide vapor barrier per structural specifications.

2.5 CONTROLLED LOW-STRENGTH MATERIAL (CLSM

2.5.1 Materials for CLSM

a. Provide flowable fill containing, at a minimum, cementitious materials and water. Cementitious materials shall be Portland cement, pozzolanic materials, or other self-cementing materials, or combinations thereof, at the Contractor's option and following approval by the COR. The flowable fill mix design may also contain fine aggregate or filler, and/or chemical admixtures in any proportions such that the final product meets the strength, flow consistency and shrinkage requirements included in this Specification, as approved by the COR.

b. Portland Cement:

(1) ASTM C150/C150M, Type II.

(2) Meeting South Dakota State DOT standards.

c. Mixing Water:

(1) Fresh, clean, and potable.

(2) Meeting South Dakota State DOT standards as water for use in Portland Cement Concrete.

d. Air-Entraining Admixture: ASTM C260/C260M.

e. Chemical Admixtures: ASTM C494/C494M.

f. Aggregate: ASTM C33/C33M.

2.5.2 CLSM Mix Design

a. Mix design shall produce a consistency that will result in a flowable product at the time of placement which does not require manual means to move it into place.

b. Flowable fill shall have a minimum strength of 100 psi according to ASTM C39/C39M at 28 days after placement.

c. Flowable fill shall have a minimum subsidence and bleed water shrinkage. Evaporation of bleed water shall not result in shrinkage of more than 1/8 inch per foot of flowable fill depth (for mixes containing high fly ash content). Measurement of a Final Bleeding shall be as measured in Section 10 of ASTM C940 "Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory.

d. Flowable fill shall have a unit weight of 115-145 lbs/feet 3 measured at the point of placement after a 60 minute ready-mix truck ride. In the absence of strength data the cementitious content shall be a maximum of 150 lbs/cy.

e. Flowable fill shall have an in-place yield of at least 98 percent of design yield for permanent type, a maximum of 110 percent of design yield for removable types at 1 year.

f. Provide equipment as recommended by the manufacturer and comply with manufacturer's recommendations for the addition of additives, whether at the production plant or prior to placement at the Site.

## PART 3 EXECUTION

### 3.1 STRIPPING OF TOPSOIL

Where directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site any surplus of topsoil from excavations and gradings.

### 3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill and unsatisfactory excavated material as specified in paragraph DISPOSITION OF SURPLUS MATERIAL. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

#### 3.2.1 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) 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. 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.

3.2.2 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical, and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in, as determined by the Contractor’s Safety Engineer or other competent person; refer to USACE publication EM 385-1-1. Excavate trench walls which are cut back to at least the angle of repose of the soil. Give special attention to slopes which may be adversely affected by weather or moisture content. Do not exceed the trench width below the pipe top of 24 inches plus pipe outside diameter (O.D.) for pipes of less than 24 inches inside diameter, and do not exceed 36 inches plus pipe outside diameter for sizes larger than 24 inches inside diameter. Where recommended trench widths are exceeded, provide redesign, stronger pipe, or special installation procedures by the Contractor. The Contractor is responsible for the cost of redesign, stronger pipe, or special installation procedures without any additional cost to the Government.

3.2.2.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 3 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.2.2 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph FILLING, BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.2.3 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

### 3.2.3 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Excavation made with power-driven equipment is not permitted within 2 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.

### 3.2.4 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the Contracting Officer prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the Contracting Officer. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D698 maximum density.

## 3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas from approved private sources. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

## 3.4 SHORING

### 3.4.1 General Requirements

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

## 3.5 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at

all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

## 3.6 GROUND SURFACE PREPARATION

### 3.6.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

### 3.6.2 Frozen Material

Do not place material on surfaces that are muddy, frozen, or contain frost. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Moisten material as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

## 3.7 UTILIZATION OF EXCAVATED MATERIALS

Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Dispose surplus satisfactory excavated material not required for fill and unsatisfactory excavated material as specified in paragraph DISPOSITION OF SURPLUS MATERIAL. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

## 3.8 BURIED TAPE AND DETECTION WIRE

### 3.8.1 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.

### 3.8.2 Buried Detection Wire

Bury detection wire directly above non-metallic piping as indicated on the drawings.

3.8.2.1 Tracer Wire for Water/Firewater/Gas

Tracer wire shall be installed along with all utility pipes as described below:

a. The tracer wire shall be extended along the pipe route. The wire shall be installed along the top of the pipe and shall be securely anchored to the pipe every 4 feet horizontally with an adhesive tape. The tracer wire shall be extended along all main branches and service lines as well.

b. At fire hydrant leads two (2) tracer wires (the upstream tracer wire and the downstream tracer wire) shall be brought along the lead and brought to the surface at the fire hydrant. The upstream and downstream tracer wire at fire hydrants shall not be tied together as this is intended to allow independent tracing of the downstream and upstream main.

c. Tracer wire shall not be installed with copper water service lines.

d. Tracer wire shall be installed with service laterals/lines. Tracer wire installed with service lines shall be installed in accordance with main requirements except that the tracer wire shall be brought to the surface at a service line valve location. Do not connect the service tracer wire to the tracer wire on the main. Tracer Wire installed along service lines shall be independent of the tracer wire installed along the main. This allows for only tracing the service line. Each service line tracer wire installation shall have its' own "Tracer Wire Access Box" installed at a service line valve location.

e. Tracer wire shall be installed with short sections of polypipe spanning all pipe joints to protect tracer wire.

f. A Tracer Wire Access Box shall be installed at Fire Hydrants in all cases and at valve boxes or other locations. The Tracer Wire Access Box shall be centered 6 inches to 12 inches behind the fire hydrant. Both the upstream and downstream tracer wires shall be installed in the Tracer Wire Access Box. The tracer wires shall be taped to the Fire hydrant Barrel in at least five locations below the ground surface. The tracer wire shall be extended at least three (3) feet above the top of the Access Box, the wires connected to the Access Box lid, the wires folded, and inserted back into the Access Box for storage. The wire shall be easily retrievable for connection to and subsequent tracing.

g. AU tracer Wire connections shall be accomplished through the use of "pig-tails". All splices and "pig-tails" shall be accomplished by stripping the wires to be connected, twisting the wires together, securing the connection by using an appropriately sized wire nut, and then preserving the splice or "pig-tail" by using a direct bury splice kit.

h. Tracer wire conduit shall be attached to the fire hydrant barrel section prior to backfill. The Tracer Wire Access Box may be installed after initial backfill.

3.8.2.2 Tracer Wire for Sanitary and Industrial Waste Pipes

Tracer Wire: Tracer wire shall be installed along with a1l lines as described below:

a. The tracer wire shall be extended with the service line. The wire shall be installed along the top of the pipe and shall be securely anchored to the pipe every 4 feet horizontally with an adhesive tape. The tracer wire shall be brought to the surface at each clean out or manhole and shall terminate at the service connection point on the main.

b. At locations where the service line is not being replaced entirely, the Contractor will splice the new tracer wire to the existing tracer wire at the point of reconnection. In instances where a service line is not being replaced entirely and the existing tracer wire is not encountered, the Contractor shall coil approximately five feet of wire at the reconnection location(s) to facilitate a future splice.

c. All tracer wire connections shall be accomplished with "pig-tails." All splices and "pig-tails" shall be accomplished by stripping the wires to be connected, twisting the wires together, securing the connections by using an appropriately sized wire nut, and preserving the splice or "pig-tail"·by using a direct bury splice kit.

d. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole just below the rim/lid. Furnish insulated wire over its entire length. Install wires at 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, terminate the wire in the valve pit at the pump station end of the pipe.

3.8.2.3 Acceptance

As a condition of project acceptance, Contractor personnel shall be able to successfully electronically trace all newly installed tracer wire/water mains. Contractor shall connect to tracing wires at every Fire Hydrant location and energize all water mains between that fire hydrant and the surrounding fire hydrants. The Contractor is responsible for coordinating conductivity testing with Contracting Officer prior to finish surfacing activities. If the tracer wire does not function as intended, the Contractor shall repair the system to the satisfaction of the Contracting Officer. The Contracting Officer shall inspect all underground splices and "pig tails" prior to backfilling.

3.9 FILLING, BACKFILLING AND COMPACTION

Place fill and backfill beneath and adjacent to any and all type of structures, in successive horizontal layers of loose material not more than 8 inches in depth, or in loose layers not more than 5 inches in depth when using hand-operated compaction equipment. Compact to at least 90 percent of laboratory maximum density for cohesive materials or 95 percent of laboratory maximum density for cohesionless materials, except as otherwise specified. Perform compaction in such a manner as to prevent wedging action or eccentric loading upon or against the structure. Moisture condition fill and backfill material to within range of +2 or -2 percent of optimum moisture content at the time of compaction.

Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

Site fill materials, including engineered fill below foundations and slabs, must be placed in 6 to 12-inch loose lifts and compacted to the densities and moisture contents outlined in soil compaction criteria table. Any additional moisture required to achieve compaction in a layer should be added and the entire lift mixed to obtain uniform moisture content.

Soil Compaction Criteria

| Placement Location | Soil Type | Moisture Content | Compaction Degree* |
|---|---|---|---|
| Scarification of Subgrade<br>Utility Trench Backfill<br>Foundation & Floor Subgrade<br>Foundation/Retaining Wall Backfill<br>Pavement Subgrade<br>Sidewalk Subgrade | Free-Draining Materials (Stabilization Rock and Sand and Gravels - Less Than 8% Fines) | Workable | 90% Max. Unit Weight (ASTM D4253) |
| | Cohesive Materials (Clays and Silts) | 0 to 3% Above Optimum | 90% (ASTM D1557) |
| | Cohesionless Materials (Engineered fill and Sands and Gravels - More Than 8% Fines) | Workable | 95% (ASTM D1557) |
| Site Grading Approx. 15 Feet Away from Structures<br>Landscape Areas | Cohesive Materials (Clays and Silts) | +3% of Optimum | 85% (ASTM D1557) |
| | Cohesionless Materials (Sands and Gravels - More Than 8% Fines) | Workable | 90% (ASTM D1557) |

*unless noted otherwise in this specification

3.9.1 Trench Backfill

Backfill trenches to the grade shown. Backfill the trench to 2 feet above the top of pipe prior to performing the required pressure tests. Leave the joints and couplings uncovered during the pressure test. Do not

backfill the trench until all specified tests are performed.

3.9.1.1 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.

3.9.1.2 Bedding and Initial Backfill

Provide bedding of the type and thickness shown. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to ensure thorough compaction of the fill under the haunches of the pipe. 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. Compact backfill to top of pipe to 95 percent of ASTM D698 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

3.9.1.2.1 Class I

Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

3.9.1.2.2 Class II

Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

3.9.1.2.3 Sand

Clean, coarse-grained sand classified as SW or SP by ASTM D2487 for bedding and backfill.

3.9.1.2.4 Gravel and Crushed Stone

Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as having a classification of GW GP in accordance with ASTM D2487 for bedding and backfill. Do not exceed maximum particle size of 3 inches.

3.9.1.3 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

3.9.1.3.1 Roadways and Airfields

Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.

3.9.1.3.2 Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas

Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.9.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 7 days, place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.9.3 Application of Flowable Fill

a. Secure pipes and other members to be backfilled beneath with flowable fill. Ensure that there are no exposed metallic pipes, conduits, or other items that will be in contact with the flowable fill after placement. If so, apply manufacturer's recommended coating to protect metallic objects before placing the flowable fill. Protection of metallic objects is subject to the approval of the Contracting Officer.

b. Protect exposed surfaces of flowable fill from premature drying, wash by rain or running water, wind, mechanical injury, and excessively hot or cold temperature. Curing method shall be subject to approval by the Contracting Officer.

3.10 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.10.1 Gas Distribution

Excavate trenches to a depth that will provide a minimum 18 inches of cover in rock excavation and a minimum 24 inch of cover in other excavation.

3.10.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 6 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. For fire protection yard mains or piping, an additional 12 inch of cover is required.

3.10.3 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.11 EMBANKMENTS

3.11.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or

frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 8 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise break up each layer; moisten or aerate as necessary; thoroughly mix; and compact in accordance with the Soil Compaction Criteria table in Paragraph FILLING, BACKFILLING, AND COMPACTION.

Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

## 3.12 SUBGRADE PREPARATION

### 3.12.1 Proof Rolling

After the subgrade soils have been scarified and recompacted and immediately prior to placing the next pavement or fill section, finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. Proof roll the limits of the pavement areas with six passes of a dump truck loaded with 4 cubic yards of soil. Operate the truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. When proof rolling, provide one-half of the passes made with the roller in a direction perpendicular to the other passes. Notify the Contracting Officer a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the Contracting Officer. Undercut rutting or pumping of material as directed by the Contracting Officer and replace with engineered fill material.

### 3.12.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

### 3.12.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, compact each layer of the embankment to at least 95 percent of laboratory maximum density See Soil Compaction Criteria table in Paragraph FILLING, BACKFILLING, AND COMPACTION.

3.12.3.1 Subgrade for Pavements

Compact the top 12 inches of subgrade for pavements in accordance with the soil compaction criteria table in Paragraph FILLING, BACKFILLING, AND COMPACTION for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 12 inch of subgrade.

3.12.3.2 Subgrade for Airfield Pavements

Compact top 12 inches below finished pavement or top 12 inches of subgrades, whichever is greater, to 90 percent of ASTM D1557; compact fill and backfill material to 90 percent of ASTM D1557. The top 6 inches of native cohesive subgrade should be compacted to 90 percent of ASTM D1557. For cohesive soils, the fill should be compacted to 90 percent of ASTM D1557. For cohesionless soils, the fill should be compacted to 95 percent of ASTM D1557 with the top 6 inches of the subgrade being compacted to 100 percent of ASTM D1557.

3.13 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.13.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.13.2 Vapor Barrier

Place a vapor barrier under concrete floor and area-way slabs grade directly on the engineered fill as indicated on the structural drawings.

3.13.3 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.14 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly

to a thickness of 4 inch and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from offsite areas.

## 3.15 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the Contracting Officer.

a. Determine field in-place density in accordance with ASTM D1556/D1556M or ASTM D6938. When ASTM D6938 is used, check the calibration curves and adjust using only the sand cone method as described in ASTM D1556/D1556M. ASTM D6938 results in a wet unit weight of soil in determining the moisture content of the soil when using this method.

b. Check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938; check the calibration of both the density and moisture gauges at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, remove the material, replace and recompact to meet specification requirements.

c. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

### 3.15.1 Fill and Backfill Material Gradation

One test per 5,000 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM C136/C136M.

### 3.15.2 In-Place Densities

a. One test per 1,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 100 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 2,500 square feet for non-airfield pavement areas.

d. One test per 10,000 square feet per 8 inch lift for general site fill.

e. One test per 12 inch lift per 200 linear feet, or fraction thereof, of

each lift of embankment or backfill for utility trenches.

3.15.3 Check Tests on In-Place Densities

If ASTM D6938 is used, check in-place densities by ASTM D1556/D1556M as follows:

a. One sand and one density check test per lift for each eight nuclear density tests.

b. One check test per lift for each 2,500 square feet, of fill or backfill areas compacted by hand-operated machines.

c. One check test per lift for each 1,000 linear feet, or fraction thereof, for roads and airfields.

3.15.4 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the Contracting Officer.

3.15.5 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.15.6 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.15.7 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the Contracting Officer. Inspect pipe sizes larger than 36 inches, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.15.8 Controlled Low-Strength Materials (CLSM)

a. Sampling and Acceptance:

(1) Flowable fill shall be sampled and tested in the field in conformance with either ASTM C94/C94M or ASTM C685/C685M. Samples for tests shall be taken for every 150 cubic yards of material, or fraction thereof, for each day's placement. Tests shall include temperature reading and four compressive strength cylinders. Compressive strength sampling and testing shall conform to

ASTM D4832 with one specimen tested at 7 days, two at 28 days, and one held for each batch of four specimens. Sampling and testing shall be preformed by a qualified, independent commercial testing laboratory. Test results should be submitted within 48 hours of completion of testing.

## 3.16 DISPOSITION OF SURPLUS MATERIAL

Surplus material and excavated unsatisfactory material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber shall be removed from Government property and properly disposed of in accordance with all applicable laws and regulations.

Excavated soil, brush, refuse, sumps, roots, and timber that requires disposal shall be addressed in the Waste Management Plan. Waste soil that is hazardous must be disposed of in accordance with Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS. Contaminated soil that is not a hazardous waste will be required to be disposed of at the Rapid City Landfill in accordance with Section 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS. Soil that is not contaminated and is non-hazardous may be disposed of at other types of facilities such as a C&D disposal facility.

-- End of Section --

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SECTION 31 63 33

MICROPILES
**12/97**

PART 1 GENERAL

1.1 SUMMARY

Work must consist of designing, furnishing, installing, monitoring, and testing of the Micropiles, as detailed on the contract drawings, per the specifications described herein. The Contractor must assume responsibility for the design and performance of the micropile foundation system. Contractor mist install Micropiles which meet the requirements indicated in paragraph PERFORMANCE CRITERIA. Each micropile must be constructed by drilling through the overburden soil into the bearing stratum and installing permanent steel casing to the required depth and achieving the required length of bond zone in the bearing stratum. This design bond zone length is commonly referred to as the "rock socket". The entire bond zone will rely on the bond capacity between the grout and the bearing stratum, and must be drilled into the bearing stratum, meeting criteria described herein. The open borehole is injected with grout at the bottom of the pile, filling entire volume of bond zone and casing. The specified reinforcement must then be installed with centralizers before the grout begins to set. The locations of pile caps, Design Loads, and conceptual micropile geometry will be provided on the drawings, but the size and spacing of each micropile within the pile cap is the responsibility of the contractor.

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 basic designation only.

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A36/A36M | (2019) Standard Specification for Carbon Structural Steel |
| ASTM A252 | 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 A615/A615M | (2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A722/A722M | (2015) Standard Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete |

| | |
|---|---|
| ASTM C109/C109M | (2021) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) |
| ASTM C150/C150M | (2022) Standard Specification for Portland Cement |
| ASTM C188 | Standard Test Method for Density of Hydraulic Cement |
| ASTM C494/C494M | (2019; E 2022) Standard Specification for Chemical Admixtures for Concrete |
| ASTM D1143/D1143M | (2007; R 2013) Piles Under Static Axial Compressive Load |
| ASTM D3689 | (2022) Standard Test Methods for Deep Foundations Under Static Axial Tensile Load |
| ASTM D3966/D3966M | (2022) Standard Test Methods for Deep Foundations Under Static Lateral Load |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS D1.1/D1.1M | (2020; Errata 1 2021) Structural Welding Code - Steel |

## 1.3 APPLICABLE PUBLICATION

Unless otherwise specified herein, all micropile construction and testing must be in accordance with the Federal Highway Administration Manual: FHWA NHI-05-039 "Micropile Design and Construction".

## 1.4 MEASUREMENT AND PAYMENT

### 1.4.1 General

All costs in connection with furnishing all materials, equipment, and performing all labor for the construction of the micropiles, including disposal of spoil materials from excavation, inspection, testing, mobilization and demobilization, rock probe holes, and load testing, complete as shown on the contract drawings and specifications, must be paid for as lump sum.

#### 1.4.1.1 Presence of Contracting Officer

All measurements must be made in the presence of the Contracting Officer.

#### 1.4.1.2 Protection and Records

Payment will not be made for any work for which satisfactory records, as determined by the Contracting Officer, are not furnished. Drilling logs must be maintained in accordance with paragraph "Drilling Logs".

#### 1.4.1.3 Criteria for Bidding

The contractor must refer to structural drawings for preliminary pile layouts. In absence of information, the Contractor must assume that a

minimum of 3 micropiles will be installed at each pile cap.

1.4.2 Bearing Stratum Probe Holes for Micropile Pile Caps

Verification of competent bedrock at all micropile locations (for bond zone capacity of each micropile and for global stability within pile cap) is the part of the Contractor's micropile design. Therefore, payment for bearing stratum probing will be part of the lump sum. If the micropile installation ensures global stability without additional (deeper) testing, than bearing stratum probe holes are not necessary. The contract lump sum price must constitute full compensation for furnishing all plant, labor, equipment, materials, and supplies, grouting of rock probe holes and performing all operations required for the completion of all work specified in paragraph "Bearing Stratum Probe Holes".

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following must be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Micropile Drawings; G-AE

SD-03 Product Data

Steel Reinforcement; G-AE

SD-05 Design Data

Grout Mix Design; G-AE

Submit grout mix design for approval at least 30 days prior to the production of micropiles. Include test results for the proposed grout mix.

Grouting Plan; G-AE

Submit grouting pan with complete description and details for the following; Methods and equipment for accurately monitoring and recording the grout depth, volume and pressure as grout is placed, and Procedure and equipment for Contractor monitoring of grout quality.

Micropile Design Analysis; G-RO

Submit design analysis with calculations for the micropile deep foundation system to the Contracting Officer's Geotechnical Engineer for review and acceptance. Design Analysis must meet requirements in paragraph DESIGN CRITERIA and address all necessary installation methods, pile diameter, length, spacing, and geometry, steel reinforcement, etc., and must discuss the required bond length in rock, and top and bottom of bond zone, with consideration for voids and weathered rock encountered during drilling. The Design Analysis must explicitly state how design capacities will be achieved, to handle the service loads provided

at each micropile cap location. Design Analysis must also address global stability. This submittal must be sealed by a registered professional engineer in the Commonwealth of Pennsylvania.

SD-06 Test Reports

Drilling Logs; G-AE

Detailed records in an approved form, for each micropile, showing shaft diameter, top and bottom elevations, bearing strata description, rock elevations, length and diameter of all temporary casing used in making the excavation, water conditions including the bottom condition at the commencement of concrete placement, concrete strength, concrete slump, concrete volume, dates of excavation and concrete placement, and other pertinent information. A record of each micropile must be delivered to the Contracting Officer within 24 hours of it's completion and a final package with all records must be submitted at the completion of drilled pier activities. Upon completion of micropile construction, the Contractor must provide a record of centerline locations based on the survey of the registered surveyor or engineer provided by the Contractor. In addition, corrective measures must be similarly recorded. A complete tabulation of all records pertaining to approved micropiles must be delivered to the Contracting Officer.

Mill Test Reports; G-AE

Submit mill test reports for steel pipe and bar reinforcement showing the results of tests conducted in accordance with ASTM Specifications.

Grout Strength Tests; G-AE

Submit test results for compressive strength testing on grout samples taken from grout mixed for micropile construction.

SD-07 Certificates

Survey; G-RO

A certified copy of the survey. Lines and levels must be established and micropile centerline locations staked and maintained by a registered surveyor or engineer provided by the Contractor.

Qualifications; G-RO

Qualifications of the foundation system Contractor must show that he has been engaged in the successful installation of micropile deep foundations for at least 5 years. Qualifications of the Geotechnical Engineer must show that he has a minimum of 5-years experience in drilled pier construction.

Mill Certifications; G-RO

Submit mill certifications for steel pipe and bar reinforcement.

## 1.6 QUALITY CONTROL

### 1.6.1 Qualifications

The micropile contractor will be experienced in the design, construction, and load testing of micropiles in limestone geology. Submit documentation to exhibit successful completion of no less than five (5) micropile projects in the past ten (10) years in pinnacled limestone geology of similar scope and size. Include a brief project description, including soil and rock descriptions, with owner's name, current phone number, micropile construction details, structural details, and load test reports for each of the previous micropile projects. Submit resumes of superintendent/foreman, driller, and supervising project engineer to be assigned to this project. Submit resumes for each individual assigned to this project that summarize work experience on at least three (3) projects of similar scope and size as this project.

### 1.6.2 Quality Control

Government and Micropile Contractor must meet at the job site prior to commencing micropile construction. Attendees must include: Construction Manager, Micropile Contractor, Geotechnical Engineers (both the Contractor's and the Government's), Contracting Officer, and QA personnel. The meeting must discuss the Micropile Design, Construction Methods, Work Plan, Specifications, and resolve any conflicts related to the construction of micropiles.

### 1.6.3 Field Testing

Field testing must be performed by the contractor's Geotechnical Engineer, to meet requirements listed in section TESTING AND EVALUATION.

## 1.7 PROJECT/SITE CONDITIONS

### 1.7.1 Subsurface Data

The Contractor must pay particular attention to the subsurface exploration logs, the drilling notes, and groundwater levels contained in the contract documents. It is suggested that the bidders examine the actual soil samples and rock core samples to determine what equipment and methods will be necessary to construct the micropiles to achieve required bearing capacity. Subsurface boring logs are shown on the drawings. The Geotechnical Report and soil and rock core samples from the subsurface investigation are available for examination by bidders by notifying the Corps of Engineers. Advance notice must be given so these samples can be made available.

### 1.7.2 Bearing Stratum Characteristics

#### 1.7.2.1 General

The bearing capacity of the bearing stratum used for design purposes is not necessarily indicative of the hardness or the difficulty in removal of the bearing stratum which will be encountered in the excavation above the planned micropile design bond zone (rock socket).

#### 1.7.2.2 Characteristics

Site specific bearing stratum characteristics are contained in the

Geotechnical Report and additional information is shown on the Structural Drawings.

## 1.8 SURVEYS

Lines and levels must be established, and micropile locations staked and maintained by a registered surveyor or engineer provided by the Contractor. A certified copy of the Survey must be submitted to the Contracting Officer.

## 1.9 SEQUENCE OF WORK

The sequence of micropile construction must be coordinated with other construction operations in order to minimize interferences. Micropile construction should not begin until after excavation and placement of fill has been completed within the building footprint unless otherwise approved by the Contracting Officer. Excavation for groups of micropiles must be performed so that reinforcing steel and grout placement is a continuous operation performed the same day that the excavation is completed. For unforeseen reasons when excavations cannot be filled with grout the same day the excavation is completed, the rock socket must be protected and cleaned just prior to placing concrete. Concrete must be placed within 3 hours after approval of the completed excavation.

## 1.10 DIMENSIONS

Micropiles must be circular in cross section. The Contractor must submit a Micropile Design Analysis which must include all micropile sizing and spacing and must match the micropile cap locations and details shown on the contract drawings. The Contract Drawings show a preliminary and conceptual design of micropiles and pile caps, which must be verified based on the final design performed by the Contractor.

## 1.11 SUPERVISION, INSPECTION, AND RECORDS

### 1.11.1 Contractor Supervision

The Contractor must provide for the supervision of all phases of micropile construction. Supervision must be the Contractor's responsibility as outlined in section QUALITY CONTROL. Each micropile excavation must be checked by the Contractor for its depth, workmanship, and for all tolerance requirements before any grout is placed.

### 1.11.2 Geotechnical Inspection

An independent licensed Professional Engineer with expertise in Geotechnical Engineering, herein before and hereafter referred to as the Geotechnical Engineer, must be paid for by the Contractor and must be provided for micropile inspection and to oversee the recording and monitoring of all micropile construction. This includes completing and submitting the Drilling Logs, and preforming the requirements specified in section QUALITY CONTROL and TESTING AND EVALUATION. Each micropile excavation must be checked by the Geotechnical Engineer to ensure that it meets the requirements herein and supplementary guidance provided by the Contracting Officer. The Geotechnical Engineer must have at least 5 years experience in micropile construction. This Geotechnical engineer must not be confused with the Contracting Officer's Geotechnical Engineer.

1.11.3 Government Inspection

In addition to the inspection by the Geotechnical Engineer, the Contracting Officer may inspect each micropile excavation and all drilling logs. After inspection of the drilling logs, any micropile that is determined to be unacceptable must be replaced by the contractor, at no additional cost to the Government.

1.11.4 Drilling Logs

An accurate record must be kept by the Contractor of each micropile as drilled (installed). Records must identify the micropile as indicated on the drawings. A record of each micropile must be delivered to the Contracting Officer within 24 hours of it's completion and a final package with all records must be submitted at the completion of micropile activities. The Contractor must furnish detailed records in an approved form for each micropile, showing diameters, locations and depth of test holes, top and bottom elevations, design bond zone (rock socket) description, rock elevations for top of bedrock, and top and bottom of rock socket, length and diameter of all casing used in making the excavation, water conditions, grout strength, grout volume, date micropile is excavated, date and time of commencement and completion of grout placement, steel reinforcement placement, plumbness and direction of deviation in plumbness, and any other pertinent information. Upon completion of micropile work, the Contractor must provide a record of as-excavated centerline locations based on the survey of the registered surveyor or engineer provided by the Contractor. In addition, corrective measures must be similarly recorded. A complete tabulation of all records pertaining to approved micropile must be delivered to the Contracting Officer. Records must be signed by the inspector and the Contractor's superintendent.

1.12 ALLOWABLE TOLERANCES

1. Centerline of micropiles to be within 2 inches from indicated plan location.

2. Pile must be plumb within 2 percent of total length plan alignment. Pile length must be determined based on the final design performed by the Contractor.

3. Top elevation of pile must be within plus or minus 1 inch from vertical elevation indicated on plans.

4. Centerline of reinforcement pipe must not be more than 1/2 inch from location indicated in the Contract Drawings.

1.13 DESIGN CRITERIA

1.13.1 General

The micropiles must be designed to meet the capacities (unfactored service loads) shown on the contract drawings, for both compression (downward) and tension (uplift). At locations where pile caps are adjacent to shallow foundations, micropiles must also be designed to support induced stress from adjacent footings. The calculations and drawings supporting design capacities must be included with the Micropile Design Analysis submitted to the Government for review and acceptance.

The overall length of each micropile will be determined such that the required capacity is developed through shear bond capacity between grout and the length of contact with competent soil bearing stratum. This length of contact (surface area) with competent soil bearing stratum is defined as the rock bond zone, and also referred to as the "rock socket". The design analysis must address how competent soil bearing stratum will be determined during drilling and construction of micropiles, but must meet the minimum requirement stated herein. Micropiles must be constructed to a minimum length of 10 feet into competent soil bearing stratum, or to the length of bond zone determined in the approved Micropile Design Analysis, whichever length is greater. Micropile must be a minimum diameter of 6 inches. Voids encountered within the bond zone must not exceed 6 inches for any individual void and the total sum of voids within the bond zone must not be more than 12 inches.

The proposed micropile connection to pile cap must be provided in the Micropile Design Analysis and must be integrated with pile caps as shown on drawings.

1.13.2 Factor of Safety - Axial

Use a factor of safety of 3 to determine the minimum design capacity for each micropile. The provided capacity for both compression (downward) and tension (uplift) must be at least three times the unfactored service load provided on drawings.

1.13.3 Buckling

Micropiles must also be designed to resist buckling. This criteria must be satisfied for the scenario of sinkhole formation, in which all lateral support form overburden soil is lost. Use a factor of safety of 2 for buckling failure.

1.13.4 Global Stability

Design for micropiles must address the global stability of a single micropile and micropile group at each pile cap. It is possible that large voids will exist beneath micropiles, even when bond zones are achieved in competent bedrock. It is necessary to ensure that no void exists beneath a micropile group, to a sufficient depth beneath the bottom of the bond zone. With sufficient competent soil bearing stratum below the bond zone of each micropile, any load on a group would be sufficiently distributed into surrounding rock below the pile tip, in the event of a void collapse. To verify global stability, probe hole testing must be completed in accordance with paragraph TESTING AND EVALUATION.

1.14 MICROPILE DRAWINGS

1.14.1 Micropile Detail(s)

The micropile detail(s) must include design load, pile type, pile diameter & length, casing and reinforcement dimensions, elevations for top of competent rock, bond zone length, and foundation connection (top of pile). If multiple micropile types are to be used, include details for each type.

1.14.2 Connection Detail(s)

Connection detail(s) must show how micropile will be structurally

connected to pile cap(s), to effectively transfer all loads shown on drawings to micropile foundation. If multiple connection types are to be used, include details for each type. If the pile caps shown on drawings are not sufficient for micropile connections, then an alternative pile cap design must be provided with the design analysis to included drawings and calculations. Connections must be designed in accordance with FHWA NHI-05-038 "Micropile Design and Construction". Structural Design of any individual element not covered by the FHWA Manual must be in accordance with ACI 31B Building Code

1.14.3 Construction (Work) Plan

Submit layout drawings indicating proposed installation sequence of micropiles. On this sequential layout, indicate locations of piles with dimensioning, pile type, elevation, installation sequence number, etc. Submit detailed written description of the proposed micropile construction procedure, list of equipment to be used, and plan describing the control/disposal of surface water, drill flush and excess waste grout. Include a step by step description of the proposed micropile construction procedure, including personnel testing, and equipment to assure quality control. This step by step procedure must be shown on the shop drawings in sufficient detail to allow the engineer to monitor construction and quality of the micropiles.

1.15 LOAD TEST

Load Test must be performed in accordance with ASTM D1143/D1143M (compressive), ASTM D3689 (tensile), and/or ASTM D3966/D3966M (lateral), as appropriate.

PART 2 PRODUCTS

2.1 STEEL REINFORCEMENT

Steel pipe conforming to ASTM A252 Grade 3 with minimum yield strength of 80 ksi. Welded seams and splices must be complete penetration welds. When welded for structural purposes the following material conditions apply: The carbon equivalency (CE) as defined in AWS D1.1/D1.1M, Section XI5.1, must not exceed 0.45, as demonstrated by mill certifications.

Threaded couplers are not permitted for splicing the reinforcement pipe. Threaded casing joints must develop at least the required compressive and tensile capacities achieved by each micropile.

2.2 GROUT

Neat Cement Grout with a minimum 28-day Compressive strength of 5,000 psi per ASTM C109/C109M.

Cement must be a type II or V cement manufactured in accordance with ASTM C150/C150M.

Water to Cement ratio must be 0.40.

All admixtures, if used, must conform to ASTM C494/C494M. Accelerators will NOT be permitted.

2.3 STEEL PLATES AND SHAPES

ASTM A36/A36M or ASTM A572/A572M, Grade 50.

2.4 CENTRALIZERS

Centralizers used for installation of reinforcing steel must be fabricated from Schedule 40 PVC pipe or tube, steel, or material that is non-detrimental to the reinforcing steel.

2.5 BAR REINFORCEMENT

ASTM A615/A615M Grade 60 or 75, or ASTM A722/A722M Grade 150. Bar couplers, if required, must develop the ultimate compressive and/or tensile strength of the steel reinforcement.

PART 3 EXECUTION

3.1 SITE PREPARATION

Site grading, to include excavation for cuts and placement of fills must completed prior to beginning micropile construction. Excavation for pile caps must also be completed prior to beginning micropile construction.

3.2 EXCAVATION

3.2.1 General

Excavation for micropiles must be whatever method necessary to excavate to the required dimensions and elevations. When the excavation has been started by one method and it is found impractical to complete it by such method, the work must be continued by other methods, but without additional cost to the Government, nor must completion of the contract be delayed thereby.

3.2.2 Classification of Excavation

Excavation must be classified as described in Specification Section 31 00 00 EARTHWORK.

3.2.3 Casing

3.2.3.1 General

During excavation of micropiles, the surrounding materials above the rock socket must be adequately and securely protected against cave-ins, displacement, and from seepage of groundwater or storm water by means of steel casings and/or by other approved methods. The inside of steel casings must be thoroughly cleaned and oiled before reuse.

3.2.3.2 Size

Removable-type temporary protective steel casing must have outside diameters greater than the indicated rock socket diameter to allow excavation of the rock socket with the protective casing in place. Casing must be a minimum of 0.25 inches thick, but must be of sufficient thickness to resist lateral earth pressures and water pressures for the size and depth of drilled pier required. All casing must be clean and free of dents.

3.2.3.3 Extent of Casing

The casing must be provided for the full depth of the overburden soil in each drilled micropile.

The limestone is pinnacled and therefore the elevations of competent rock will vary throughout the site. Voids are also present creating unpredictability in the elevations of suitable bearing rock. Due to the variability of the top of rock and depth to sound competent rock and presence of voids, the Contractor must anticipate considerable variations in protective casing lengths.

3.2.3.4 Effects of Groundwater

All casings must be sufficiently watertight to prohibit the entrance of water in order that the excavation, inspection, and cleanup operations can take place.

3.2.4 Spoil Materials

Spoil materials from excavation of micropiles must be disposed of in spoil areas in accordance with Specification Section 31 00 00 EARTHWORK.

3.2.5 Blasting

Blasting is not permitted in micropile excavation. Excavation of the micropiles must be limited to appropriate drilling equipment and/or air hammers with suitable attachments.

3.2.6 Dust Control

The use of air for the removal of cuttings from the micropile excavation is permissible provided dust control measures are employed. The measures to be employed are to be clearly stated, in writing, and approved by the Contracting Officer prior to commencement of any operations utilizing air.

3.2.7 Protection

3.2.7.1 Fresh Grout

Micropile drilling and installation must not take place within 20 feet of grout less than 3 days old.

3.2.7.2 Top of Hole

Provide protection around the top of the excavation to prevent debris and earth from being dislodged into the excavation and grout, and to prevent the inflow of surface water into the excavation and grout.

3.2.8 Spoils, Surface Water, and Excess Grout

The contractor is responsible for control and disposal of surface water, drill flush, and excess grout. Drill flush and drill spoils will be handled as excavated spoils and stockpiled or removed off site in accordance with Specification Section 31 00 00 EARTHWORK. The site must be graded to direct water to appropriate storm water management features and/or erosion controls. Any waste grout must be segregated from other spoils and placed with washed grout.

## 3.3 MICROPILE INSTALLATION

### 3.3.1 General

Micropile Contractor must select the drilling method, grouting procedure, grouting pressure, and the load test requirement (if necessary) to construct the micropiles. Drilling equipment and methods must be suitable for drilling through the conditions shown on the boring logs included with the contract drawings. Expect to penetrate intermittent hard rock layers, weathered and broken rock layers, voids, soil seams and to encounter steeply dipping rock pinnacles above the top of competent rock. Drill hole must be unobstructed along its full length and width prior to pacing grout and reinforcement. Casing or other approved methods of drill hole support will be required. Use of drilling fluid containing bentonite is not allowed. Proposed methods for drill hole support and for prevention of detrimental ground movement must be included the Micropile Design Analysis. Predrilling the borehole and allowing hole to stand open is not acceptable. Control surface water by gravity flow or pumping to remove from site Collection of water within or near the building footprint is not allowed. Prevent any flow of surface water into previously drilled micropile locations. Dispose on site water in accordance with approved Erosion and Sediment plans, and local, state, and federal regulations. Do not allow water to accumulate at pile locations. Sumps within or near the building footprint must be lined with impermeable materials. Expect variability in finished micropile lengths.

### 3.3.2 Casing

The Contractor must provide Mill Test Reports as indicated in Section 1.5. The contractor is responsible for maintaining an open hole. As drilling advances to the required depth into competent soil bearing stratum, contact between the drill casing and the borehole must be maintained. After drilling to tip elevation and extending casing to top of bond zone, internal rods must be withdrawn. If steel casing is to be used as the designed reinforcement, than this should be described in the Micropile Design Analysis. Spliced casings must also be described in the analysis, and must be installed in a manner to avoid eccentric loading.

### 3.3.3 Steel Reinforcement

The Contractor must provide Mill Test Reports as indicated in Section 1.5. If central reinforcement is required for design, than it must be installed prior to grouting the micropile, or immediately after placement before grout begins to set. Centralizers must be used to ensure the reinforcement is installed with the correct alignment. Centralizers must be spaced at a maximum 10 feet on center, with the upper and lower centralizer within 3 feet of the end of reinforcement. Centralizers must permit free flow of grout without misplacement of reinforcement. If placing into wet grout, driving or forcing of the bar is not permitted.

### 3.3.4 Grouting

The Contractor must provide a Grouting Plan as indicated in Section 1.5. Grout must be consistent with Grout Mix Design submitted to the Government for approval. Grout micropiles the same day the bond zone is drilled. Grout must be free of lumps and undispersed cement. Place grout within one hour of mixing in one continuous operation. Inject grout from the lowest point of the drillhole and continue until uncontaminated grout

flows from the top of the pile. Extract temporary casing (if used) in stages, such that level of grout is maintained at ground surface. The tremie pipe and casing must always extend below the level of the existing grout in the drill hole. Control grout pressures and grout takes to prevent excessive heave or fracturing of rock or soil formations. The contractor must have a method of measuring grout quantity and pumping pressure during grouting operations. The grout pump must be equipped with a pressure gauge to monitor pressures of at least 150 psi or twice the actual grout pressure used, whichever is greater. The contractor is responsible for limiting grout flow by either staging the grouting operation or thickening the grout. The grout strength must not be compromised. No additional payments for excessive grout volumes will be made.

## 3.4 TESTING AND EVALUATION

The Contractor must give his full cooperation in the performance of the testing and evaluation program and must allow the following reasonable times for evaluation of the test results by the Contracting Officer:

a. Grout Testing: Testing described herein must be completed for each micropile.

b. Bearing Elevation: The approved top and bottom of bond zone for each micropile will be determined during drilling and verified by the Contracting Officer's Engineer after evaluation of the Drilling Logs.

c. Rock Probe Holes: Per section 1.4.2.

d. Load Test: Per section 1.15.

### 3.4.1 Grout Testing

The Contractor must provide Grout Strength Tests as indicated in Section 1.5. Test compressive strength of grout samples in accordance with ASTM C109/C109M. Test must consist of 3 grout cubes, with the achieved Compressive Strength to be the average of all 3 cubes. Test grout density in accordance with ASTM C188. Test must consist of 3 grout cubes, with the achieved Density to be the average of all 3 cubes. Density must be within 5 percent of the approved Grout Mix Design. Compressive Strength and Density must be tested for each micropile.

### 3.4.2 Load Test

Load test must be conducted on a test (verification) micropile before beginning installation of production piles. Test verification pile to a maximum test load of 2 times the service load, as shown on the contract drawings. For compressive loads, load test must be conducted in accordance with ASTM D1143/D1143M, Quick Test Method. For uplift loads, load test must be conducted in accordance with ASTM D3689. Load test(s) is to verify the construction methods are sufficient to construct a micropile achieving the required design capacity within the bond zone determined during drilling. Results must be approved by the Contracting Officer before construction of production piles can begin. Construction methods for production piles must be identical to those used for test pile.

The maximum verification test load applied to the micropile must not exceed 80 percent of the structural capacity of the micropile structural

elements, to include steel yield strengths and grout compression. The hydraulic jack must be positioned at the beginning of the test such that unloading and repositioning during the test will not be required. Furnish a report consisting of a summary sheet, load settlement graph, test micropile drilling logs, and time-load-settlement data in addition to items required by ASTM D1143/D1143M and ASTM D3689, respectively, within seven working days after completion of the load test. Do not exceed a vertical displacement of 1 inch at any time. If micropile fails, the Contractor must modify the design, construction procedure, or both, as necessary to produce a micropile capable of completing a successful load test. Modification must be submitted to the Contracting Officer's Geotechnical Engineer for review and approval. All modifications must be at the expense of the contractor.

3.4.3 Rock Probe Holes

Where inspection of rock quality is necessary beneath bond zone depths, the Contracting Officer will direct that a probe hole be performed. Since verification of competent bearing stratum at all micropile locations, for bond zone capacity of each micropile, and for global stability, is the part of the Contractor's micropile design, payment for rock probing will be included with the lump sum. If the micropile installation ensures global stability without additional (deeper) testing, than rock probe holes are not necessary. When evaluation is complete and approved by the Contracting Officer, the probe hole must be backfilled as required by the Contracting Officer.

a. Rock Probe Hole Drilling: The probe hole must be used to evaluate the rock below the proposed bond zone elevation. The equipment used must be a percussion drill capable of drilling a vertical hole approximately 2 inches in diameter to required depth. The drilling must be accomplished under a relatively uniform downward pressure in a manner such as to avoid binding the drill bit. The size of the bit may be reduced as the hole is deepened, if necessary, to avoid binding. The drilled hole will be probed with a "feeler" rod to determine whether a suitable bearing surface has been reached or whether the micropile will have to be deepened.

b. "Feeler" Rods: The Contractor must provide the rock probe (feeler) rod made from a 3/8 or 1/2 inch steel reinforcing bar. The bar must be 9 feet long and must have a right angled chisel point formed at the end

c. Record Of Rock Probing: The Contractor must keep accurate records of all rock probing accomplished under this contract and must deliver complete, legible copies of these records to the Contracting Officer upon completion of each rock probe hole or at such other time or times as directed. All such records must be preserved in good condition and order by the Contractor until they are delivered and accepted, and the Contracting Officer must have the right to examine such records at any time prior to their delivery to him.

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HOT-MIX BITUMINOUS BASE COURSE FOR ROADS AND STREETS
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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.

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 |

ASPHALT INSTITUTE (AI)

| | |
|---|---|
| AI MS-2 | (2015) Asphalt Mix Design Methods |

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 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 C183/C183M | (2015) Standard Practice for Sampling and the Amount of Testing of Hydraulic Cement |
| ASTM D75/D75M | (2019) Standard Practice for Sampling Aggregates |

| | |
|---|---|
| ASTM D140/D140M | (2016) Standard Practice for Sampling Asphalt Materials |
| ASTM D242/D242M | (2009; R 2014) Mineral Filler for Bituminous Paving Mixtures |
| ASTM D1856 | (2009; R 2015) Recovery of Asphalt from Solution by Abson Method |
| 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 D2216 | (2019) Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass |
| ASTM D2726/D2726M | (2019) Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous 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 D4318 | (2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils |
| ASTM D4791 | (2019) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate |
| ASTM D4867/D4867M | (2009; R 2014) Effect of Moisture on Asphalt Concrete Paving Mixtures |
| ASTM D5821 | (2013; R 2017) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate |
| ASTM D6373 | (2016) Standard Specification for Performance Graded Asphalt Binder |
| 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 |

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

Sources of Aggregates

Job Mix Formula; G-AE

SD-06 Test Reports

Sources of Aggregates

Bituminous Materials

Service Record

SD-09 Manufacturer's Field Reports

Batch Tickets

1.3 QUALITY CONTROL

1.3.1 Qualifications

Perform sampling and testing using an approved commercial testing laboratory or on-site facilities. Submit accreditation of the commercial laboratory by an independent evaluation authority, indicating conformance to ASTM D3666, including all applicable test procedures. Do not start work requiring testing until the facilities have been inspected and approved. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory validation is not allowed. Maintain this certification for the duration of the project.

1.3.2 Test Results

Verify that materials comply with the specification. When a material source is changed, test the new material for compliance. When deficiencies are found, repeat the initial analysis and retest the material already placed to determine the extent of unacceptable material. Replace or repair all in-place unacceptable material to conform to the contract requirements. Submit copies of field tests results within 24 hours after the tests are performed and certified copies of tests results for approval not less than 30 days before material is required for the work.

1.3.3 Batch Tickets

Provide batch tickets in accordance with AASHTO M 156.

1.3.4 Aggregates

Select sources of aggregates and submit a plan for operation of a new source of aggregates at least 45 days in advance of starting production.

If a previously developed source is selected, submit test results with evidence that central plant hot-mix bituminous pavements constructed with the aggregates have had a satisfactory service record of at least 5 years under similar climatic conditions. Include in the service record a tabulation of aggregate gradation and quality test results, typical hot-mix asphalt mix design using the aggregate, and a list of representative paving projects using the aggregate. Make such tests and other investigations as necessary to determine whether or not aggregates meeting the requirements specified can be produced from the proposed sources. Sample aggregates in accordance with ASTM D75/D75M and test them at the start of production.

1.3.5 Mineral Filler

Sample mineral filler in accordance with ASTM C183/C183M.

1.3.6 Bituminous Materials

Select sources where bituminous materials are obtained in advance of time when materials will be required in the work. Sample bituminous materials in accordance with ASTM D140/D140M. Submit test results not less than 30 days before such material is required for use in the work.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not construct bituminous courses when the underlying course contains free surface water, or when temperature of the surface of the underlying course is below 40 degrees F, unless otherwise directed.

1.5 ACCEPTANCE

1.5.1 Tolerances

Acceptance of bituminous base course is based on compliance with the tolerances presented in Table 1. Remove and replace bituminous base course represented by the failing tests or submit repair plan for approval.

TABLE 1

| Attribute | Measurement |
|---|---|
| Plant Mixture | |
| Delivery to Laydown Machine | Minimum 250 deg F |
| Laboratory Air Voids | 3 to 5 percent |
| Finished Mat | |
| Mat Density (avg of 4 cores/lot) | Minimum 92 percent of TMD |
| Joint Density (avg of 4 cores/lot) | Minimum 90.5 percent of TMD |
| Grade | plus/minus 0.05 foot |

| TABLE 1 | |
|---|---|
| Smoothness | plus/minus 3/8 inch |
| Longitudinal Joint Offset | Minimum 1 foot |
| Transverse Joint Offset | Minimum |

PART 2 PRODUCTS

2.1 AGGREGATES

Provide aggregates consisting of crushed stone, crushed gravel screenings, sand, and mineral filler, as required. The portion of these materials retained on the No. 4 sieve is classified as coarse aggregate; the portion passing the No. 4 sieve and retained on the No. 200 sieve, as fine aggregate; and the portion passing the No. 200 sieve, as mineral filler.

2.1.1 Coarse Aggregates

Provide coarse aggregates consisting of clean, sound, durable fragments of crushed stone, crushed slag, or crushed gravel meeting the following requirements:

2.1.1.1 Aggregate Wear

Percentage of wear not exceeding 40 after 500 revolutions, as determined in accordance with ASTM C131/C131M.

2.1.1.2 Aggregate Loss

Percentage of loss not exceeding 18 after five cycles performed in accordance with ASTM C88, using magnesium sulfate.

2.1.1.3 Fractured Faces

At least 75 percent by weight of coarse aggregate containing two or more fractured faces produced by crushing when tested in accordance with ASTM D5821.

2.1.1.4 Flat and Elongated Pieces

Particle shape essentially cubical and containing not more than 20 percent, by weight, of flat particles and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D4791.

2.1.1.5 Dry Weight of Crushed Slag

Dry weight of crushed slag not less than 75 pcf as determined in accordance with ASTM C29/C29M.

2.1.2 Fine Aggregates

Provide fine aggregates consisting of clean, durable natural sands; manufactured sands prepared by crushing stone, slag, or gravel, or any combination of natural and manufactured sands. Natural sands consist of

grains of clean, hard, durable rock. Limit the quantity of uncrushed material to a maximum of 25 percent by weight of total aggregate.

2.1.3 Mineral Filler

Mineral filler conforming to ASTM D242/D242M.

2.1.4 Liquid Limit and Plasticity Index

Measure liquid limit and plasticity index on the portion of the aggregate passing the No. 40 sieve in accordance with ASTM D4318. Requirements apply to the individual aggregate fractions and the combined blend in the completed base course. Provide aggregates classified as either nonplastic or having a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.2 BITUMINOUS MATERIALS

2.2.1 Asphalt Cement

Provide asphalt cement binder conforming to ASTM D6373 Performance Grade (PG) 64-28, or PG 64-34.

2.3 AGGREGATE GRADATION

Provide mineral aggregate of such size that percentage composition by weight, as determined by ASTM C136/C136M, conforms to the gradation specified in TABLE 2, and does not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

TABLE 2. AGGREGATE GRADATION

| Percent Passing | |
|---|---|
| Sieve Size | Gradation 1 |
| 1 inch | 100 |
| 3/4 inch | 90-100 |
| 1/2 inch | 68-88 |
| 3/8 inch | 60-82 |
| No. 4 | 45-67 |
| No. 8 | 32-54 |
| No. 16 | 22-44 |
| No. 30 | 15-35 |
| No. 50 | 9-25 |
| No. 100 | 6-18 |

| TABLE 2. AGGREGATE GRADATION | |
|---|---|
| Percent Passing | |
| Sieve Size | Gradation 1 |
| No. 200 | 3-6 |

2.4 COMPOSITION OF MIXTURE

2.4.1 Job-Mix Formula (JMF)

2.4.1.1 Develop the JMF

Provide an asphalt mix composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt binder. Size the aggregate fractions, handle in separate size groups, and combine in such proportions that the resulting mixture meets the grading requirements of Table 2. Submit proposed JMF; do not produce hot-mix asphalt for payment until a JMF has been approved. Design the hot-mix asphalt in accordance with Marshall or Superpave procedures and the criteria shown in Table 3. Use the hand-held hammer to compact the specimens for Marshall mix design. Design Superpave mixes with the number of gyrations specified in Table 3, unless the DOT option is chosen. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D4867/D4867M, is less than 75, reject the aggregates or treat the asphalt mixture with an approved anti-stripping agent. Add the amount of anti-stripping agent sufficient to produce a TSR of not less than 75. Provide an antistrip agent, if required, at no additional cost. Provide sufficient materials to produce 200 pound of blended mixture for verification of mix design at least 14 days prior to construction of test section.

2.4.1.2 Option

A currently used DOT Superpave hot mix may be used in lieu of developing a Marshall hot mix design as described herein. Design the Superpave volumetric mix in accordance with AI MS-2 and ASTM D6925. Provide a nominal maximum aggregate size (NMAS) of 1/2 inch. Other DOT hot mix design methods may be suitable, as approved. Select the number of compaction gyrations, Ndes, based on a design traffic of less than 0.3 million equivalent single axle loads (ESALs).

2.4.2 JMF Requirements

Submit in writing the job mix formula for approval at least 30 days prior to the start of the test section including as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt binder.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt performance grade viscosity grade.

e. Number of blows of hand-held hammer per side of molded specimen. (NA for Superpave)

f. Number of gyrations of Superpave gyratory compactor, (NA for Marshall mix design)

g. Laboratory mixing temperature.

h. Lab compaction temperature.

i. Temperature-viscosity relationship of the asphalt cement.

j. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

k. Graphical plots of stability (NA for Superpave), flow (NA for Superpave), air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2.

l. Specific gravity and absorption of each aggregate.

m. Percent natural sand.

n. Percent particles with 2 or more fractured faces (in coarse aggregate).

o. Fine aggregate angularity.

p. Percent flat or elongated particles (in coarse aggregate).

q. Tensile Strength Ratio(TSR).

r. Antistrip agent (if required) and amount.

s. List of all modifiers and amount.

t. Correlation of hand-held hammer with mechanical hammer (NA for Superpave).

u. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 3. Mix Design Criteria

| Test Property | 50 Blows or Mix Gyrations |
|---|---|
| Stability, pounds, minimum (NA for Superpave) | *1350 |
| Flow, 0.01 inch, (NA for Superpave) | 8-18 |
| Air voids, percent | 3-5 |
| Percent Voids in mineral aggregate (VMA),(minimum) | |
| Gradation 1 | 14.0 |

| Table 3. Mix Design Criteria | |
|---|---|
| Test Property | 50 Blows or Mix Gyrations |
| TSR, minimum percent | 75 |
| * This is a minimum requirement. | |
| ** Calculate VMA in accordance with AI MS-2, based on ASTM C127 and ASTM C128 bulk specific gravity for the aggregate. | |

2.4.2.1 Adjustment to JMF

The JMF for each mixture is in effect until a new formula is approved in writing. Should a change in sources of any materials be made, perform a new mix design and obtain approval before the new material is used. Make minor adjustments within the specification limits to the JMF to optimize mix volumetric properties. Adjustments to the original JMF are limited to plus or minus 4 percent on the No. 4 and coarser sieves; plus or minus 3 percent on the No. 8 to No. 50 sieves; and plus or minus 1 percent on the No. 100 sieve. Adjustments to the JMF are limited to plus or minus 1.0 percent on the No. 200 sieve. Asphalt content adjustments are limited to plus or minus 0.40 from the original JMF. If adjustments are needed that exceed these limits, develop a new mix design.

2.5 EQUIPMENT, TOOLS, AND MACHINES

2.5.1 Bituminous Plant

Provide a bituminous plant of such capacity to produce the quantities of bituminous mixtures required for the project within the completion time of the contract. Provide hauling equipment, paving machines, rollers, miscellaneous equipment, and tools in sufficient numbers and capacity and in proper working condition to place the bituminous paving mixtures at a rate equal to the plant output. Provide a sufficient number of adequately trained personnel during paving operations to produce a pavement meeting the requirements in this specification.

2.5.2 Mixing Plants

Provide mixing plants in accordance with AASHTO M 156 which are automatic or semiautomatic controlled, commercially manufactured units designed, coordinated, and operated to consistently produce a mixture within the job-mix formula (JMF). Prequalify drum or batch mixers at the production rate to be used during actual mix production. The prequalification tests include extraction in accordance with ASTM D2172/D2172M and recovery of the asphalt binder in accordance with ASTM D1856.

2.5.3 Hauling Equipment

Provide trucks for hauling hot-mix asphalt having tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, lightly coat the truck beds with a release agent specifically designed for use with hot mix asphalt. Provide each truck with a suitable cover to protect the mixture from adverse weather. When necessary to maintain the mixture at

the specified temperature, insulate or heat truck beds and securely fasten covers (tarps).

2.5.4 Rollers

Provide the number, type, and weight of rollers sufficient 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 or displacement of the asphalt mixture.

2.5.5 Straightedge

Furnish and maintain at the site, in good condition, one 12 foot straightedge for each bituminous paver for use in testing the finished surface. Construct straightedges of aluminum with blades of box or box-girder cross section and a flat bottom reinforced to insure rigidity and accuracy. Provide handles to facilitate movement on pavement.

PART 3 EXECUTION

3.1 CONDITIONING OF UNDERLYING COURSE

Prior to placing the bituminous base course, clean the underlying surface of foreign or objectionable matter. Apply a prime coat in accordance with 32 12 13 BITUMINOUS TACK AND PRIME COATS.

3.2 MIXING

3.2.1 Preparation of Mineral Aggregates

Place and maintain each aggregate stockpile in such a manner to prevent segregation. Regulate rates of feed of aggregates so that the moisture content and temperature of aggregates will be within tolerances specified herein. Provide dry storage for mineral filler.

3.2.2 Preparation of Bituminous Mixtures

Convey aggregates, mineral filler, and bitumen into the mixer in proportionate quantities required to meet the JMF. Set the mixing time as required to obtain a uniform coating of the aggregate with the bituminous material. Limit the temperature of bitumen at time of mixing not to exceed 300 degrees F. Maintain the temperature of aggregate and mineral filler in the mixer within the range of 265 to 320 degrees F when bitumen is added. Overheated and carbonized mixtures or mixtures that foam will be rejected.

3.2.3 Water Content of Aggregates

Perform drying operations to reduce the water content of mixture to less than 0.75 percent. Conduct the water content test in accordance with ASTM D2216. If the water content is determined on individual hot bin samples, calculate the water content as a weighted average based on composition of blend.

3.2.4 Storage of Bituminous Paving Mixture

Store the mixture according to the requirements of AASHTO M 156. Empty uninsulated surge bins at the end of each working day. If excessive heat loss, segregation,or oxidation of the stored asphalt mixture is observed,

discontinue the use of the surge bin.

## 3.3 TRANSPORTATION OF BITUMINOUS MIXTURE

Transport the bituminous mixture from the paving plant to the site in trucks having tight, clean, smooth beds lightly coated with an approved release agent to prevent adhesion of mixture to truck bodies. Drain excessive release agent prior to loading. Cover each load with canvas or other approved material of ample size to protect mixture from weather and prevent loss of heat. Reject loads that have crusts of cold, unworkable material or have become wet by rain. Do not haul over freshly placed material.

## 3.4 PLACING

Do not place bituminous mixtures without ample time to complete placement and compaction during daylight hours, unless artificial lighting is provided.

### 3.4.1 Offsetting Joints in Bituminous Base Course

Place the bituminous base course so that longitudinal joints are offset from joints in the underlying course by at least 1 foot. Offset transverse joints by at least 2 feet from transverse joints in the underlying course.

### 3.4.2 Placing Strips Succeeding Initial Strips

In placing each succeeding strip after the initial strip has been spread and compacted as specified below, overlap the screed of the laydown machine 1/2 to 1 inch over the previously placed strip and sufficiently high so that compaction will produce a smooth, dense joint. Use a lute to push back the mixture placed on the edge of the previously placed strip to the edge of the strip being placed. Do not broadcast material onto the mat. Remove and waste excess mixture.

### 3.4.3 Hand Spreading in Lieu of Machine Spreading

In areas where the use of machine spreading is impractical, spread the mixture by hand. Prevent segregation during spreading. Do not broadcast material onto the mat. Remove and waste excess mixture. Maintain grade and smoothness tolerances presented in Table 1.

## 3.5 COMPACTION OF MIXTURE

Begin compaction as soon after placing as the mixture will bear roller without undue displacement. Do not permit delays in compacting the freshly placed mixture. After the initial rolling, perform preliminary tests of the crown, grade, and smoothness. Correct deficiencies so that the finished course will conform to requirements for the grade and smoothness specified in subpart: ACCEPTANCE. After meeting crown, grade, and smoothness requirements, continue rolling until a mat density of at least 92 percent of the theoretical maximum density (TMD) determined in accordance with ASTM D2041/D2041M is obtained. Roll the joints until until a joint density of at least 90.5 percent of the theoretical maximum density (TMD) determined in accordance with ASTM D2041/D2041M is obtained. Thoroughly compact areas inaccessible to rollers with hot hand tampers.

3.5.1 Correcting Deficient Areas

Remove mixtures that become contaminated or are defective. Do not permit skin patching of an area that has been rolled. Cut holes the full thickness of the base course so that the sides are perpendicular and parallel to the direction of traffic and the edges are vertical. Spray sides with tack coat conforming to requirements of Section 32 12 13 BITUMINOUS TACK AND PRIME COATS. Place hot mix asphalt in the holes in sufficient quantity so that the finished surface will conform to grade, smoothness, and density requirements.

3.6 JOINTS

3.6.1 General

Carefully construct joints between old and new pavements or between successive day's work or joints that have become cold to establish a continuous bond between old and new sections of the course. Construct joints having the same texture, density, and smoothness as other sections of the course. Clean contact surfaces of previously constructed pavements that have become coated with dust, sand, or other objectionable material by brushing or cut back with approved power saw, as approved. Spray the surface against which new material is placed with a thin, uniform coat of tack coat conforming to requirements of Section 32 12 13 BITUMINOUS TACK AND PRIME COATS. Apply the material far enough in advance of placement of the fresh mixture to insure adequate curing. Take care to prevent damage or contamination of sprayed surface.

3.6.2 Transverse Joints

Pass the roller over the unprotected end of freshly placed mixture only when placing of the course is discontinued or when delivery of the mixture is interrupted to the extent that the unrolled material may become cold. In all cases, cut back the edge of the previously placed course a mimimum of 2 inches to expose an even, straight, vertical surface for the full thickness of the course. In continuing placement of the strip, position the mechanical spreader on the transverse joint so that sufficient hot mixture will be spread to obtain a joint after rolling that conforms to the required density and smoothness specified herein.

3.6.3 Longitudinal Joints

Cut back edges of a previously placed strip that have cooled or are irregular, honeycombed, poorly compacted, damaged, or otherwise defective. In all cases, cut back the edge of the previously placed course a mimimum of 2 inches to expose an even, straight, vertical surface for the full thickness of the course.

3.7 EDGES OF PAVEMENT

Neatly trim outside edges adjacent to shoulders.

3.8 QUALITY CONTROL

Perform tests in sufficient numbers and at the locations and times directed to ensure that materials, mixtures and compaction meet specified requirements. Obtain samples of finished pavement, including samples that span the longitudinal joint. Sample bituminous materials during construction when shipments of bituminous materials are received or when

necessary to assure that some condition of handling or storage has not been detrimental to the bituminous material.

3.8.1 Sampling

Obtain plant mix and in-place samples on a lot and sublot basis. Each full day's production or a maximum of 1000 tons is considered a lot. Divide the lot into four (4) equal sublots and obtain random samples in accordance with ASTM D3665 within each sublot. Obtain plant mix samples from the haul truck or from behind the paver. Test for grade and smoothness on a total lot basis.

3.8.2 In-Place Density

Take one random core (4 inches or larger in diameter) from the mat (interior of the lane) of each sublot, and one random core from the joint (immediately over joint) of each sublot, with each random core the full thickness of the layer being placed. When the random core is less than 1 inch thick, do not include in the analysis. In this case, take another random core. After air drying to a constant weight, determine the density of each core in accordance with ASTM D2726/D2726M. Determine percent compaction using the TMD. Evaluate for acceptance in accordance with subpart: ACCEPTANCE. Remove and replace unacceptible lots.

3.8.3 Laboratory Air Voids and Theoretical Maximum Density

Calculate laboratory air voids by determining the bulk density of each lab compacted specimen using the laboratory-prepared, thoroughly dry method of ASTM D2726/D2726M and determining the theoretical maximum density of each sublot sample using ASTM D2041/D2041M. Use the latest theoretical maximum density value to calculate the laboratory air voids for each sublot. Evaluate for acceptance in accordance with subpart: ACCEPTANCE. Complete and report all laboratory air void tests within 24 hours after completion of construction of each lot.

3.8.4 Plan Grade

Provide finished surfaces conforming, within tolerances specified, to the lines, grades, and cross sections indicated. Do not permit finished surfaces to vary more than the tolerances provided in subpart: ACCEPTANCE from the plan gradeline and elevation established and approved at the site. Maintain finished surfaces flush with finished surfaces of abutting pavements. Do not permit deviations from the plan gradeline and elevation in areas of pavements where closer conformance with plan grade and elevation is required for the proper functioning of drainage and other appurtenant structures involved.

3.8.5 Surface Smoothness

Provide finished surfaces not deviating from the testing edge of a straightedge more than the tolerances of subpart: ACCEPTANCE in any direction.

3.8.6 Temperatures

Check temperatures at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

## 3.9 PROTECTION OF PAVEMENT

After final rolling of the pavement, do not permit vehicular traffic of any kind until the pavement has cooled to ambient temperature.

-- End of Section --

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BITUMINOUS TACK AND PRIME COATS

**05/17**

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BITUMINOUS TACK AND PRIME COATS
**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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO T 102 | (2009; R 2013) Standard Method of Test for Spot Test of Asphaltic Materials |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM D140/D140M | (2016) Standard Practice for Sampling Asphalt Materials |
| ASTM D977 | (2020) Standard Specification for Emulsified Asphalt |
| ASTM D2027/D2027M | (2019) Cutback Asphalt (Medium-Curing Type) |
| ASTM D2397/D2397M | (2019a) Standard Specification for Cationic Emulsified Asphalt |
| ASTM D2995 | (1999; R 2009) Determining Application Rate of Bituminous Distributors |

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

Local/Regional Materials

SD-06 Test Reports

Sampling and Testing

1.3 QUALITY ASSURANCE

Certificates of compliance for asphalt materials delivered will be obtained and checked to ensure that specification requirements are met. Quantities of applied material will be determined. Payment will be for amount of residual asphalt applied. Tack coat materials will not be

diluted. Prime coat materials when emulsions are used can be diluted on site with potable water up to 1 part emulsion to 1 part water.

## 1.4 DELIVERY, STORAGE, AND HANDLING

Inspect the materials delivered to the site for contamination and damage. Unload and store the materials with a minimum of handling.

## 1.5 EQUIPMENT, TOOLS AND MACHINES

### 1.5.1 General Requirements

Equipment, tools and machines used in the work are subject to approval. Maintain in a satisfactory working condition at all times. Calibrate equipment such as asphalt distributors, scales, batching equipment, spreaders and similar equipment within 12 months of their use. If the calibration expires during project, recalibrate the equipment before work can continue.

### 1.5.2 Bituminous Distributor

Provide a self propelled distributor with pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the surface being sprayed. Calibrate the distributer in accordance with ASTM D2995. Design and equip the distributor to spray the bituminous material in a uniform coverage at the specified temperature, at readily determined and controlled total liquid rates from 0.03 to 1.0 gallons per square yard, with a pressure range of 25 to 75 psi and with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Include with the distributor equipment a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor will be capable of circulating and agitating the bituminous material during the heating process.

### 1.5.3 Heating Equipment for Storage Tanks

Use steam, electric, or hot oil heaters for heating the bituminous material. Provide steam heaters consisting of steam coils and equipment for producing steam, so designed that the steam cannot come in contact with the bituminous material. Fix an armored thermometer to the tank with a temperature range from 40 to 400 degrees F so that the temperature of the bituminous material may be determined at all times.

### 1.5.4 Power Brooms and Power Blowers

Use power brooms and power blowers suitable for cleaning the surfaces to which the bituminous coat is to be applied.

## 1.6 ENVIRONMENTAL REQUIREMENTS

Apply bituminous coat only when the surface to receive the bituminous coat is dry. A limited amount of moisture (approximately 0.03 gallon/square yard) can be sprayed on the surface of unbound material when prime coat is used to improve coverage and penetration of asphalt material. Apply bituminous coat only when the atmospheric temperature in the shade is 50

degrees F or above and when the temperature has not been below 35 degrees F for the 12 hours prior to application, unless otherwise directed.

## PART 2 PRODUCTS

### 2.1 PRIME COAT

Provide asphalt conforming to one of the following grades:

#### 2.1.1 Cutback Asphalt

Provide cutback asphalt conforming to ASTM D2027/D2027M, Grade MC-30 MC-70.

#### 2.1.2 Emulsified Asphalt

Provide emulsified asphalt conforming to ASTM D977, Type SS-1 SS1h ASTM D2397/D2397M, Type CSS-1 CSS-1h. Asphalt emulsion can be diluted up to 1 part water to 1 part emulsion for prime coat use. Do not dilute asphalt emulsion for tack coat use.

### 2.2 TACK COAT

#### 2.2.1 Emulsified Asphalt

Provide emulsified asphalt conforming to ASTM D977, Type RS-1 SS-1 SS1h ASTM D2397/D2397M, Type CSS-1 CSS-1h. For prime coats the emulsified asphalt can be diluted with up to 1 part emulsion to 1 part water. No dilution is allowed for tack coat applications. The base asphalt used to manufacture the emulsion is required to show a negative spot when tested in accordance with AASHTO T 102 using standard naphtha.

#### 2.2.2 Local/Regional Materials

Use Local/Regional Materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources. See Section 01 33 29 SUSTAINABILITY REPORTING for cumulative total local material requirements. Tack and prime coat materials may be locally available.

## PART 3 EXECUTION

### 3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, remove all loose material, dirt, clay, or other objectionable material from the surface to be treated by means of a power broom or blower supplemented with hand brooms. Apply treatment only when the surface is dry and clean.

### 3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

#### 3.2.1 Tack Coat

Apply bituminous material for the tack coat in quantities of not less than 0.03 gallons nor more than 0.10 gallons per square yard of residual asphalt onto the pavement surface as approved by the Contracting Officer. Do not dilute asphalt emulsion when used as a tack coat.

3.2.2 Prime Coat

Apply bituminous material for the prime coat in quantities of not less than 0.05 gallons nor more than 0.12 gallons per square yard of residual asphalt for asphalt emulsion up to a 1 to 1 dilution rate or for residual asphalt for cutback asphalt.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Apply asphalt at a temperature that will provide a viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 centistokes, kinematic. Furnish the temperature viscosity relation to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements determine the application temperature to be used. The following is a normal range of application temperatures:

| Cutback Asphalts | |
|---|---|
| MC-30 | 85-190 degrees F |
| MC-70 | 120-225 degrees F |
| Asphalt Emulsion | |
| All Grades | 70-160 degrees F |
| Asphalt Cement | |
| All Grades | 275-350 degrees F |

Some of these temperatures for rapid cure cutbacks are above the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, apply the bituminous prime or tack coat with the bituminous distributor at the specified rate with uniform distribution over the surface to be treated. Properly treat all areas and spots, not capable of being sprayed with the distributor, with the hand spray. Until the succeeding layer of pavement is placed, maintain the surface by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, spread clean dry sand to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment are permitted within 25 feet of heating, distributing, and transferring operations of cutback materials. Prevent all traffic, except for paving equipment used in constructing the surfacing, from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat

requirements are described herein.

3.4.2 Prime Coat

Apply a prime coat at locations shown on the Drawings. The prime coat is required if it will be at least 7 days before the asphalt mixture is constructed on the underlying (base course, etc.) compacted material. The type of liquid asphalt and application rate will be as specified herein. Protect the underlying layer from any damage (water, traffic, etc.) until the surfacing is placed. If the Contractor places the surfacing within seven days, the choice of protection measures or actions to be taken is at the Contractor's option. Repair (recompact or replace) damage to the underlying material caused by lack of, or inadequate, protection by approved methods at no additional cost to the Government. If the Contractor opts to use the prime coat, apply as soon as possible after consolidation of the underlying material. Apply the bituminous material uniformly over the surface to be treated at a pressure range of 25 to 75 psi; the rate will be as specified above in paragraph APPLICATION RATE. To obtain uniform application of the prime coat on the surface treated at the junction of previous and subsequent applications, spread building paper on the surface for a sufficient distance back from the ends of each application to start and stop the prime coat on the paper and to ensure that all sprayers will operate at full force on the surface to be treated. Immediately after application remove and destroy the building paper.

3.4.3 Tack Coat

Apply tack coat at the locations shown on the drawings. A tack coat should be applied to every bound surface (asphalt or concrete pavement) that is being overlaid with asphalt mixture and at transverse and longitudinal joints. Apply the tack coat when the surface to be treated is clean and dry. Immediately following the preparation of the surface for treatment, apply the bituminous material by means of the bituminous distributor, within the limits of temperature specified herein and at a rate as specified above in paragraph APPLICATION RATE. Apply the bituminous material so that uniform distribution is obtained over the entire surface to be treated. Treat lightly coated areas and spots missed by the distributor by spraying with a hand wand or using other approved method. Following the application of bituminous material, allow the surface to cure without being disturbed for period of time necessary to permit setting of the tack coat. Apply the bituminous tack coat only as far in advance of the placing of the overlying layer as required for that day's operation. Maintain and protect the treated surface from damage until the succeeding course of pavement is placed.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of asphalt mixture allow the bituminous coat to cure and water or volatiles to evaporate prior to overlaying. Maintain the tacked surface in good condition until the succeeding layer of pavement is placed, by protecting the surface against damage and by repairing and recoating deficient areas.

3.6 FIELD QUALITY CONTROL

Obtain certificates of compliance for all asphalt material delivered to the project. Obtain samples of the bituminous material under the

supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

## 3.7 SAMPLING AND TESTING

Furnish certified copies of the manufacturer's test reports indicating temperature viscosity relationship for cutback asphalt or asphalt cement, compliance with applicable specified requirements, not less than 5 days before the material is required in the work.

### 3.7.1 Sampling

Unless otherwise specified, sample bituminous material in accordance with ASTM D140/D140M.

### 3.7.2 Calibration Test

Furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibrate using the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibrate the bituminous distributor in accordance with ASTM D2995.

### 3.7.3 Trial Applications

Before applying the spray application of tack or prime coat, apply three lengths of at least 100 feet for the full width of the distributor bar to evaluate the amount of bituminous material that can be satisfactorily applied.

#### 3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous tack coat materials in the amount of 0.05 gallons per square yard. Make other trial applications using various amounts of material as may be deemed necessary.

#### 3.7.3.2 Prime Coat Trial Application Rate

Unless otherwise authorized, apply the trial application rate of bituminous materials in the amount of 0.15 gallon per square yard. Make other trial applications using various amounts of material as may be deemed necessary.

### 3.7.4 Sampling and Testing During Construction

Perform quality control sampling and testing as required in paragraph FIELD QUALITY CONTROL.

## 3.8 TRAFFIC CONTROLS

Keep traffic off surfaces freshly treated with bituminous material. Provide sufficient warning signs and barricades so that traffic will not travel over freshly treated surfaces.

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PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES
**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 CONCRETE INSTITUTE (ACI)

| | |
|---|---|
| ACI 211.1 | (1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete |
| ACI 305R | (2020) Guide to Hot Weather Concreting |
| ACI 306R | (2016) Guide to Cold Weather Concreting |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A184/A184M | (2019) Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement |
| ASTM A615/A615M | (2022) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A775/A775M | (2017) Standard Specification for Epoxy-Coated Steel Reinforcing Bars |
| ASTM A966/A966M | (2015; R 2020) Standard Test Method for Magnetic Particle Examination of Steel Forgings Using Alternating Current |
| 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 C42/C42M | (2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete |
| ASTM C78/C78M | (2022) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading) |
| ASTM C88 | (2018) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |

| | |
|---|---|
| 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 | (2022) Standard Specification for Portland Cement |
| ASTM C171 | (2020) Standard Specification for Sheet Materials for Curing Concrete |
| ASTM C172/C172M | (2017) Standard Practice for Sampling Freshly Mixed Concrete |
| 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 C309 | (2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete |
| ASTM C494/C494M | (2019; E 2022) 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 C881/C881M | (2020a) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete |
| ASTM C1017/C1017M | (2013; E 2015) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete |
| ASTM C1077 | (2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation |
| ASTM C1260 | (2021) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method) |
| ASTM C1542/C1542M | (2019) Standard Test Method for Measuring Length of Concrete Cores |
| 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 D1751 | (2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types) |
| ASTM D2995 | (1999; R 2009) Determining Application Rate of Bituminous Distributors |

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

| | |
|---|---|
| NRMCA QC 3 | (2015) Quality Control Manual: Section 3, Plant Certifications Checklist: Certification of Ready Mixed Concrete Production 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-03 Product Data

Curing Materials

Reinforcement

Epoxy Resin

Cementitious Materials

Expansion Joint Filler

SD-05 Design Data

Mix Design Report; G-AE

SD-06 Test Reports

Concrete Slump Tests

Concrete Uniformity

Flexural Strength

Air Content

SD-07 Certificates

Batch Tickets

NRMCA Certificate Of Conformance

SD-08 Manufacturer's Instructions

Diamond Grinding Plan

1.3 QUALITY CONTROL

1.3.1 NRMCA Certificate of Conformance

Provide a batching and mixing plant consisting of a stationary-type central mix plant, including permanent installations and portable or relocatable plants installed on stable foundations. Provide a plant designed and operated to produce concrete within the specified tolerances, with a minimum capacity of 250 cubic yards per hour. Submit NRMCA Certificate of Conformance that conforms to the requirements of NRMCA QC 3 including provisions addressing:

1. Material Storage and Handling

2. Batching Equipment

3. Central Mixer

4. Ticketing System

5. Delivery System

1.3.2 Qualifications

1.3.2.1 Laboratory Accreditation

Perform sampling and testing using an approved commercial testing laboratory or on-site facilities that are accredited in accordance with ASTM C1077. Do not start work requiring testing until the facilities have been inspected and approved. The Government will inspect all laboratories requiring validation for equipment and test procedures prior to the start of any concreting operations for conformance to ASTM C1077. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory validation is not allowed. Maintain this certification for the duration of the project.

1.3.2.2 Field Technicians

Provide field technicians meeting one of the following criteria:

a. Have at least one National Ready Mixed Concrete Association (NRMCA) certified concrete craftsman and at least one American Concrete Institute (ACI) Flatwork Finisher Certified craftsman on site, overseeing each placement crew during all concrete placement.

b. Have no less than three NRMCA certified concrete installers and at least two American Concrete Institute (ACI) Flatwork Finisher Certified installers on site working as members of each placement crew during all concrete placement.

1.3.3 Batch Tickets

Submit batch tickets for each load of ready-mixed concrete in accordance with ASTM C94/C94M.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver concrete paving in accordance with ASTM C94/C94M.

1.5 ACCEPTANCE

1.5.1 Tolerances

Acceptance of Portland cement concrete pavement is based on compliance with the tolerances presented in Table 1. Remove and replace concrete pavement represented by the failing tests or submit repair plan for approval.

Table 1

| Measurement | Tolerance |
|---|---|
| PLASTIC CONCRETE | |
| Slump | plus 0, minus 1.5 inches |
| Air Content | plus/minus 1.5 percent |
| Flexural Strength | No individual specimen less than 100 psi below specified strength. |
| HARDENED CONCRETE | |
| Grade | plus/minus 0.05 feet from plan |
| Smoothness | No abrupt change exceeding 1/8 inch |
| Straightedge | Not more than 1/4 in. |
| Thickness | minus 3/4 inch for pavement equal to/greater than 8 inches thick<br>minus 1/2 inch for pavement less than 8 inches thick. |
| Edge Slump | 85 percent less than 1/4 inch and 100 percent less than 3/8 inch. |

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Provide cementitious materials in concrete mix with 20 to 50 percent non-portland cement pozzolanic materials by weight.

2.1.1.1 Portland Cement

Conforming to ASTM C150/C150M, Type I or II.

2.1.1.2 Blended Cement

Provide blended cement conforming to ASTM C595/C595M, Type IP or IS, including the optional requirement for mortar expansion and sulfate soundness. Provide pozzolan added to the Type IP blend consisting of ASTM C618 Class F or Class N and that is interground with the cement clinker. Include in written statement from the manufacturer that the amount of pozzolan in the finished cement does 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 are not allowed to change from that submitted for the aggregate evaluation and mixture proportioning. The requirements of paragraph Supplementary Cementitious Materials (SCM) Content do not apply to the SCM content of blended cement.

2.1.1.3 Fly Ash and Pozzolan

Conforming to ASTM C618, Type F, or N, with a loss on ignition not exceeding 3 percent. Include test results in accordance with ASTM C618.

2.1.1.4 Ultra Fine Fly Ash and Ultra Fine Pozzolan

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) conforming to ASTM C618, Class F or N, and the following additional requirements:

a. The strength activity index at 28 days of age at least 95 percent of the control specimens.

b. The average particle size not exceeding 6 microns.

c. Loss on ignition not exceeding 3 percent.

2.1.1.5 Supplementary Cementitious Materials (SCM) Content

Include one of the SCMs listed in Table 2 within the range specified therein, whether or not the aggregates are found to be reactive in accordance with the paragraph Alkali Reactivity Test.

TABLE 2
SUPPLEMENTARY CEMENTITIOUS MATERIALS CONTENT

| Supplementary Cementitious Material | Minimum Content (percent) | Maximum Content (percent) |
|---|---|---|
| Class N Pozzolan and Class F Fly Ash | | |
| $SiO_2 + Al_2O_3 + Fe_2O_3$ greater than 70 percent | 25 | 35 |
| $SiO_2 + A1_2O_3 + Fe_2O_3$ greater than 80 percent | 20 | 35 |
| $SiO_2 + A1_2O_3 + Fe_2O_3$ greater than 90 percent | 15 | 35 |
| UFFA and UFP | 7 | 16 |

2.1.2 Water

Water conforming to ASTM C1602/C1602M. Hot water will not be allowed unless approved by the Contracting Officer.

2.1.3 Aggregate

2.1.3.1 Durability

Evaluate and test all fine and coarse aggregates to be used in all concrete for durability in accordance with ASTM C88. Provide fine and coarse aggregates with a maximum of 18 percent loss when subjected to 5 cycles using Magnesium Sulfate or a maximum of 12 percent loss when subjected to 5 cycles of Sodium Sulfate.

2.1.3.2 Alkali Reactivity Test

Evaluate and test fine and coarse aggregates to be used in all concrete for alkali-aggregate reactivity. Test all size groups and sources proposed for use.

a. Evaluate the fine and coarse aggregates separately, using ASTM C1260. Reject individual aggregates with test results that indicate an expansion of greater than 0.08 percent after 28 days of immersion in 1N NaOH solution, or perform additional testing as follows: utilize the proposed low alkali portland cement, blended cement, or SCM in combination with each individual aggregate. Test in accordance with ASTM C1567. Determine the quantity that meets all the requirements of these specifications and that lowers the expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Base the mixture proportioning on the highest percentage of SCM required to mitigate ASR-reactivity.

b. If any of the above options does not lower the expansion to less than 0.08 percent after 28 days of immersion in a 1N NaOH solution, reject the aggregate(s) and submit new aggregate sources for retesting. Submit the results of testing for evaluation and acceptance.

2.1.3.3 Fine Aggregates

Conforming to the quality and gradation of ASTM C33/C33M.

2.1.3.4 Coarse Aggregates

Coarse aggregate consisting of crushed or uncrushed gravel, crushed stone, or a combination thereof. Provide aggregates, as delivered to the mixers, consisting of clean, hard, uncoated particles. Wash coarse aggregate sufficient to remove dust and other coatings. Provide fine aggregate consisting of natural sand, manufactured sand, or a combination of the two, and composed of clean, hard, durable particles. Provide both coarse and fine aggregates meeting the requirements of ASTM C33/C33M.

a. Gradation: Provide coarse aggregate with a nominal maximum size of 1.5 inches. Grade and provide the individual aggregates in two or more size groups meeting the individual grading requirements of ASTM C33/C33M, Size No. 4 (1.5 to 0.75 inch) and Size No. 67 (0.75 inch to No. 4).

b. Quality: Conforming to ASTM C33/C33M, Class 4S.

2.1.4 Chemical Admixtures

2.1.4.1 Water Reducing Admixtures

Provide admixture conforming to ASTM C494/C494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures. ASTM C494/C494M Type S specific performance admixtures and ASTM C1017/C1017M flowable admixtures are not allowed.

2.1.4.2 Air Entraining Admixture

Conforming to ASTM C260/C260M: Air-entraining.

2.1.4.3 High Range Water Reducing Admixture

ASTM C494/C494M Type F and G high range water reducing admixtures are not allowed.

2.1.5 Reinforcement

2.1.5.1 Tie Bars

Billet or axle steel deformed bars conforming to ASTM A615/A615M or ASTM A966/A966M Grade 60. Epoxy coat in accordance with ASTM A775/A775M.

2.1.5.2 Reinforcement

Deformed steel bar mats conforming to ASTM A184/A184M. Bar reinforcement conforming to ASTM A966/A966M, Grade 60.

2.1.6 Curing Materials

Provide curing materials consisting of:

2.1.6.1 White-Burlap-Polyethylene Sheet

Conforming to ASTM C171, 0.004 inch thick white opaque polyethylene bonded to 10 oz/linear yard (40 inch) wide burlap.

2.1.6.2 Liquid Membrane-Forming Compound

Conforming to ASTM C309, white pigmented, Type 2, Class B, free of paraffin or petroleum.

2.1.6.3 Liquid Chemical Sealer-Hardener Compound

Compound consisting of magnesium fluosilicate which when mixed with water seals and hardens the surface of the concrete. Do not use on exterior slabs exposed to freezing conditions.

2.1.7 Joint Fillers and Sealants

Provide as specified in Section 32 13 73.19 COMPRESSION CONCRETE PAVING JOINT SEALANT. Match new joints with existing alignment.

2.1.8 Biodegradable Form Release Agent

Provide form release agent that is colorless and biodegradable. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent with a minimum of 87 percent biobased material and does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.1.9 Epoxy Resin

Provide epoxy-resin materials that consist of two-component materials conforming to the requirements of ASTM C881/C881M, Class as appropriate for each application temperature to be encountered, except that in addition, the materials meet the following requirements:

a. Type IV, Grade 3, for use for embedding dowels and anchor bolts.

b. Type III, Grade as approved, for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar.

c. Type IV, Grade 1, for use for injecting cracks.

d. Type V, Grade as approved, for bonding freshly mixed portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete.

2.1.10 Joint Materials

2.1.10.1 Expansion Joint Materials

Provide preformed expansion joint filler material conforming to ASTM D1751. Provide expansion joint filler that is 3/4 inch thick, unless otherwise indicated, and provided in a single full depth piece.

2.2 MIX DESIGN

Proportion concrete mix in accordance with ACI 211.1 except as modified herein.

2.2.1 Specified Concrete Properties

2.2.1.1 Flexural Strength

Provide concrete with a minimum flexural strength of 650 psi at 28 days of age.

2.2.1.2 Air Entrainment

Provide an entrained air content of 5.5 percent.

2.2.1.3 Slump

For fixed form and hand placement, provide a maximum slump of 3 inches. For slipformed pavement, at the start of the project, select a maximum allowable slump which will produce in-place pavement meeting the specified tolerances for control of edge slump. The selected slump is applicable to both pilot and fill-in lanes.

2.2.1.4 Water/Cementitious Materials Ratio

Maximum allowable water-cementitious material ratio is 0.40. The water-cementitious material ratio is based on absolute volume equivalency, where the ratio is determined using the weight of cement for a cement only mix, or using the total volume of cement plus pozzolan converted to an equivalent weight of cement by the absolute volume equivalency method described in ACI 211.1.

2.2.2 Mix Design Report

Perform trial design batches, mixture proportioning studies, testing, and include test results demonstrating that the proposed mixture proportions produce concrete of the qualities indicated. An existing mix design may be submitted if developed within the previous 12 months. Submit test results in a mix design report to include:

a. Coarse and fine aggregate gradations and plots.

b. Coarse and fine aggregate quality test results, include deleterious materials and ASR testing.

c. Mill certificates for cement and supplemental cementitious materials.

d. Certified test results for all proposed admixtures.

e. Specified flexural strength, slump, and air content.

f. Recommended proportions and volumes for proposed mixture and each of three trial water-cementitious materials ratios.

g. Individual beam breaks.

h. Flexural strength summaries and plots.

i. Historical record of test results, documenting production standard deviation (if available).

j. Narrative discussing methodology on how the mix design was developed.

2.2.3 Mix Verification

Mix verification tests may be performed by the Government. Provide quantities of cementitious materials, aggregates and admixtures as requested.

2.3 EQUIPMENT

2.3.1 Batching and Mixing

Provide stationary mixers and truck mixers. Provide a batch plant conforming to ASTM C94/C94M and as specified. Do not weigh water or measure cumulatively with another ingredient. Batch all concrete materials in accordance with ASTM C94/C94M requirements. Verify batching, mixers, mixing time, permitted reduction of mixing time, and concrete uniformity in accordance with the requirements of ASTM C94/C94M, and document in the initial weekly QC Report. Do not use truck mixers for mixing slipformed concrete. Provide only truck mixers designed for mixing or transporting

paving concrete with extra large blading and rear opening specifically for low-slump paving concrete and conforming to the requirements of ASTM C94/C94M.

2.3.2 Transporting Equipment

Provide transporting equipment in conformance with ASTM C94/C94M and as specified herein. Transport concrete to the paving site in rear-dump trucks, in truck mixers designed with extra large blading and rear opening specifically for low slump concrete, or in agitators. Do not permit bottom-dump trucks for delivery of concrete.

2.3.3 Delivery Equipment

When concrete transport equipment cannot operate on the paving lane, provide side-delivery transport equipment consisting of self-propelled moving conveyors to deliver concrete from the transport equipment and discharge it in front of the paver. Do not permit front-end loaders, dozers, or similar equipment to distribute the concrete.

2.3.4 Texturing Equipment

Provide texturing equipment as specified below.

2.3.4.1 Fabric Drag

Clean, reasonably new burlap measuring from 3 to 10 feet long, 2 feet wider than the width of the pavement, and securely attached to a separate wheel mounted frame spanning the paving lane or to one of the other similar pieces of equipment. Select dimension of burlap drag so that at least 3 feet of the material is in contact with the pavement.

2.3.5 Curing Equipment

Provide equipment for applying membrane-forming curing compound mounted on a self-propelled frame that spans the paving lane. Constantly agitate the curing compound reservoir mechanically (not air) during operation and provide a means for completely draining the reservoir. Provide a spraying system that consists of a mechanically powered pump which maintains constant pressure during operation, an operable pressure gauge, and either a series of spray nozzles evenly spaced across the lane to provide uniformly overlapping coverage or a single spray nozzle which is mounted on a carriage which automatically traverses the lane width at a speed correlated with the forward movement of the overall frame. Protect all spray nozzles with wind screens. Calibrate the spraying system in accordance with ASTM D2995, Method A, for the rate of application required in subpart CURING AND PROTECTION. Provide hand-operated sprayers powered by compressed air supplied by a mechanical air compressor. Immediately replace curing equipment if it fails to apply an even coating of compound at the specified rate.

2.3.6 Sawing Equipment

Provide equipment for sawing joints and for other similar sawing of concrete consisting of standard diamond-type concrete saws mounted on a wheeled chassis which can be easily guided to follow the required alignment. Provide diamond tipped blades. If demonstrated to operate properly, abrasive blades may be used. Provide spares as required to maintain the required sawing rate. Early-entry saws may be used, subject

to demonstration and approval. No change to the initial sawcut depth is permitted.

2.3.7 Straightedge

Furnish one 12 foot straightedge constructed of aluminum or magnesium alloy, having blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Provide handles for operation on the pavement.

PART 3 EXECUTION

3.1 PREPARATION FOR PAVING

3.1.1 Weather Limitations

When windy conditions during paving appear probable, have equipment and material at the paving site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1.1 Inclement Weather

Do not commence placing operations when heavy rain or other damaging weather conditions appear imminent. At all times when placing concrete, maintain on-site sufficient waterproof cover and means to rapidly place it over all unhardened concrete or concrete that might be damaged by rain. Suspend placement of concrete whenever rain, high winds, or other damaging weather commences to damage the surface or texture of the placed unhardened concrete, washes cement out of the concrete, or changes the water content of the surface concrete. Immediately cover and protect all unhardened concrete from the rain or other damaging weather. Completely remove and replace any slab damaged by rain or other weather full depth, by full slab width, to the nearest original joint.

3.1.1.2 Hot Weather

Maintain required concrete temperature in accordance with ACI 305R to prevent evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing, place concrete during cooler night time hours, or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Water is not allowed to be added after the initial introduction of mixing water except, when on arrival at the job site, the slump is less than specified and the water-cement ratio is less than that given as a maximum in the approved mixture. Additional water may be added to bring the slump within the specified range provided the approved water-cement ratio is not exceeded. Inject water into the head of the mixer (end opposite the discharge opening) drum under pressure, and turn the drum or blades a minimum of 30 additional revolutions at mixing speed. The addition of water to the batch at any later time is not allowed. After placement, use fog spray, apply monomolecular film, or use other suitable means to reduce the evaporation rate. Start curing when surface of fresh concrete is sufficiently hard to permit curing without damage. Cool underlying material by sprinkling lightly with water before placing concrete. Follow practices found in ACI 305R.

3.1.1.3 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 ACI 305R. In addition to the protective measures specified in the previous paragraph, the concrete placement may be further protected by erecting shades and windbreaks and by applying fog sprays of water, the addition of monomolecular films, or wet covering. Apply monomolecular films after finishing is complete, do not use in the finishing process. Immediately commence curing procedures when such water treatment is stopped.

3.1.1.4 Cold Weather

Do not place concrete when ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. When authorized, when concrete is likely to be subjected to freezing within 24 hours after placing, heat concrete materials so that temperature of concrete when deposited is between 65 and 80 degrees F. Methods of heating materials are subject to approval. Do not heat mixing water above 165 degrees F. Remove lumps of frozen material and ice from aggregates before placing aggregates in mixer. Follow practices found in ACI 306R.

3.1.2 Conditioning of Underlying Material

Verify the underlying material, upon which concrete is to be placed is clean, damp, and free from debris, waste concrete or cement, frost, ice, and standing or running water. Prior to setting forms or placement of concrete, verify the underlying material is well drained and has been satisfactorily graded by string-line controlled, automated, trimming machine and uniformly compacted in accordance with the applicable Section of these specifications. Test the surface of the underlying material to crown, elevation, and density in advance of setting forms or of concrete placement using slip-form techniques. Trim high areas to proper elevation. Fill and compact low areas to a condition similar to that of surrounding grade, or fill with concrete monolithically with the pavement. Low areas filled with concrete are not to be cored for thickness to avoid biasing the average thickness used for evaluation and payment adjustment. Rework and compact any underlying material disturbed by construction operations to specified density immediately in front of the paver. If a slipform paver is used, continue the same underlying material under the paving lane beyond the edge of the lane a sufficient distance that is thoroughly compacted and true to grade to provide a suitable trackline for the slipform paver and firm support for the edge of the paving lane.

3.1.3 Forms

Use steel forms, except that wood forms may be used for curves having a radius of 150 feet or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. Provide forms with the base width not less than eight-tenths of the vertical height of the form, except that for forms 8 inches or less in vertical height, provide forms with a base width not less than the vertical height of the form. Provide wood forms adequate in

strength and rigidly braced for curves and fillets. Set forms on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Do not set forms on blocks or on built-up spots of underlying material. Before placing the concrete, coat the contact surfaces of forms with a non-staining mineral oil, non-staining form coating compound, biodegradable form release agent, or two coats of nitro-cellulose lacquer.

When using existing pavement as a form, clean existing concrete and then coat with asphalt emulsion bondbreaker before concrete is placed. Check and correct grade elevations and alignment of the forms immediately before placing concrete.

3.1.4 Reinforcement

3.1.4.1 Dowel Bars

Install dowels with horizontal and vertical alignment plus or minus 1 inch. Except as otherwise specified, maintain location of dowels within a skew alignment of 1/4 inch over 1 foot length. Reject coatings which are perforated, cracked or otherwise damaged. While handling avoid scuffing or gouging of the coatings. Omit Dowels and tie bars when the center of the dowel or tie bar is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness. Maintain dowels in position during concrete placement and curing. Before concrete placement, thoroughly grease the entire length of each dowel secured in a dowel basket or fixed form.

3.1.4.2 Tie Bars

Install bars, accurately aligned horizontally and vertically, and to the tolerances shown on the drawings, at indicated locations. For slipform construction, insert bent tie bars by hand or other approved means.

3.1.4.3 Setting Slab Reinforcement

Position reinforcement on suitable chairs prior to concrete placement. At expansion, contraction and construction joints, place the reinforcement as indicated. Clean reinforcement free of mud, oil, scale or other foreign materials. Place reinforcement accurately and wire securely. Lap splices 12 inches minimum. Maintain the bar spacing from ends and sides of slabs and joints as indicated.

3.2 MEASURING, MIXING, CONVEYING, AND PLACING CONCRETE

3.2.1 Measuring

Conform to ASTM C94/C94M.

3.2.2 Mixing

Conform to ASTM C94/C94M, except as modified herein. Begin mixing within 30 minutes after cement has been added to aggregates. When the air temperature is greater than 85 degrees F, place concrete within 60 minutes. With approval, a hydration stabilizer admixture meeting the requirements of ASTM C494/C494M Type D, may be used to extend the placement time to 90 minutes. Additional water may be added to bring slump within required limits as specified in ASTM C94/C94M, provided that the specified water-cement ratio is not exceeded.

3.2.3 Conveying

Conform to ASTM C94/C94M.

3.2.4 Placing

Do not exceed a free vertical drop of 5 feet from the point of discharge. Deposit concrete either directly from the transporting equipment or by conveyor on to the pre-wetted subgrade or subbase, unless otherwise specified. Deposit the concrete between the forms to an approximately uniform height. Place concrete continuously at a uniform rate, without damage to the grade and without unscheduled stops except for equipment failure or other emergencies. If an unscheduled stop occurs within 10 feet of a previously placed expansion joint, remove concrete back to joint, repair any damage to grade, install a construction joint and continue placing concrete only after cause of the stop has been corrected.

3.3 PAVING

Construct pavement with paving and finishing equipment utilizing fixed forms.

3.3.1 Paving Plan

Submit for approval a paving plan identifying the following items:

a. A description of the placing and protection methods proposed when concrete is to be placed in or exposed to hot, cold, or rainy weather conditions.

b. A detailed paving sequence plan and proposed paving pattern showing all planned construction joints.

c. Plan and equipment proposed to control alignment of formed or sawn joints within the specified tolerances.

3.3.2 Required Results

Operate the paver-finisher to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. Adjust the paver-finishing operation to produce a surface finish free of irregularities, tears, voids of any kind, and other discontinuities, with only a minimum of paste at the surface. Do not permit multiple passes of the paver-finisher. Produce a finished surface requiring no hand finishing, other than the use of cutting straightedges, except in very infrequent instances. Do not apply water, other than true fog sprays (mist), to the concrete surface during paving and finishing.

3.3.3 Operation

When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), make provisions to prevent damage to the previously constructed pavement, including keeping the existing pavement surface free of debris, and placing rubber mats beneath the paver tracks. Operate transversely oscillating screeds and extrusion plates to overlap the existing pavement the minimum possible, but in no case more than 8 inches.

3.3.4 Consolidation

Immediately after spreading concrete, consolidate full depth with internal type vibrating equipment along the boundaries of all slabs regardless of slab thickness, and interior of all concrete slabs. For pavements less than 10 inches thick, operate vibrators at mid-depth parallel with or at a slight angle to the base course. For thicker pavements, angle vibrators toward the vertical, with vibrator tip preferably about 2 inches above the base course, and top of vibrator a few inches below pavement surface. Automatically control the vibrators or tamping units in front of the paver so that they stop immediately as forward motion ceases. Limit duration of vibration to that necessary to produce consolidation of concrete. Do not permit excessive vibration. Vibrate concrete in small, odd-shaped slabs or in locations inaccessible to the paver mounted vibration equipment with a hand-operated immersion vibrator operated from a bridge spanning the area. Do not operate vibrators at one location for more than 15 seconds. Do not use vibrators to transport or spread the concrete.

3.3.5 Fixed Form Paving

Spread and strike off concrete with with the paver. Shape the concrete to the specified and indicated cross section in one pass, and finish the surface and edges so that only a very minimum amount of hand finishing is required. Use single spud hand vibrators to consolidate the concrete adjacent to fixed forms as required to achieve a void-free formed edge. Do not allow vibrators to contact reinforcement, forms, or the grade during vibration.

3.4 JOINTS

3.4.1 Contraction Joints

Hold dowels and tie bars in longitudinal and transverse contraction joints within the paving lane securely in place by means of rigid metal basket assemblies. Weld the dowels and tie bars to the assembly or hold firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. Anchor the basket assemblies securely in the proper location.

3.4.2 Construction Joints - Fixed Form Paving

Install dowels by the bonded-in-place method, supported by means of devices fastened to the forms. Do not permit installation by removing and replacing in preformed holes.

3.4.3 Dowels Installed In Hardened Concrete

Install by bonding the dowels into holes drilled into the hardened concrete. Drill holes into the hardened concrete approximately 1/8 inch greater in diameter than the dowels. Bond the dowels in the drilled holes using epoxy resin injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel is not permitted. Hold the dowels in alignment at the collar of the hole, after insertion and before the epoxy resin hardens, by means of a suitable metal or plastic collar fitted around the dowel. Check the vertical alignment of the dowels by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending

point of the exposed part of the dowel.

## 3.5 FINISHING CONCRETE

Start finishing operations immediately after placement of concrete. Use finishing machine, except hand finishing may be used in emergencies and for concrete slabs in inaccessible locations or of such shapes or sizes that machine finishing is impracticable. Immediately halt any operations which produce more than 1/8 inch of mortar-rich surface (defined as deficient in plus U.S. No. 4 sieve size aggregate) and modify the equipment, mixture, or procedures. Finish pavement surface on both sides of a joint to the same grade. Finish formed joints from a securely supported transverse bridge. Provide hand finishing equipment for use at all times.

### 3.5.1 Machine Finishing

Strike off and screed concrete to the required slope and cross-section by a power-driven transverse finishing machine. A transverse rotating tube or pipe is not permitted. Maintain elevation of concrete such that, when consolidated and finished, pavement surface will be adequately consolidated and at the required grade. Equip finishing machine with a screed which is readily and accurately adjustable for changes in pavement slope and compensation for wear and other causes. Do not permit excessive operation over an area, which will result in an excess of mortar and water being brought to the surface.

#### 3.5.1.1 Equipment Operation

Maintain the travel of machine on the forms without lifting, wobbling, or other variation of the machine which tend to affect the precision of concrete finish. Keep the tops of the forms clean by a device attached to the machine. Maintain a uniform ridge of concrete ahead of the front screed for its entire length.

#### 3.5.1.2 Joint Finish

Before concrete is hardened, correct edge slump of pavement, exclusive of edge rounding, in excess of 0.25 inches. Finish concrete surface on each side of construction joints to the same plane, and correct deviations before newly placed concrete has hardened.

#### 3.5.1.3 Hand Finishing

Strike-off and screed surface of concrete to elevations slightly above finish grade so that when concrete is consolidated and finished, the pavement surface is at the indicated elevation. Vibrate entire surface until required compaction and reduction of surface voids is secured with a strike-off template. After initial finishing, further smooth and consolidate concrete by means of hand-operated longitudinal floats.

### 3.5.2 Texturing

Before the surface sheen has disappeared and before the concrete hardens, provide a texture to the surface of the pavement as described herein. After curing is complete, thoroughly broom all textured surfaces to remove all debris. Finish the concrete in areas of recesses for tie-down anchors, lighting fixtures, and other outlets in the pavement to provide a surface of the same texture as the surrounding area.

3.5.2.1 Burlap Drag Finish

Before concrete becomes non-plastic, finish the surface of the slab by dragging a strip of clean, wet burlap on the surface. Drag the surface so as to produce a finished surface with a fine granular or sandy texture without leaving disfiguring marks. Keep the burlap clean and saturated during use.

3.5.3 Edging

At the time the concrete has attained a degree of hardness suitable for edging, carefully finish slab edges, including edges at formed joints, with an edge having a maximum radius of 1/8 inch. Clean by removing loose fragments and soupy mortar from corners or edges of slabs which have crumbled and areas which lack sufficient mortar for proper finishing. Refill voids solidly with a mixture of suitable proportions and consistency and refinish. Remove unnecessary tool marks and edges. Smooth remaining edges true to line.

3.6 CURING AND PROTECTION

Protect concrete adequately from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks and oil stains, and do not allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, on surfaces to be painted, where coverings are to be bonded to concrete, or on concrete to which other concrete is to be bonded.

3.6.1 Moist Curing

Maintain concrete to be moist-cured continuously wet for the entire curing period, or until curing compound is applied, commencing immediately after finishing. If forms are removed before the end of the curing period, provide curing on unformed surfaces, using suitable materials. Cure surfaces by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Provide burlap and mats that are clean and free from any contamination and completely saturated before being placed on the concrete. Lap sheets to provide full coverage. Provide an approved work system to ensure that moist curing is continuous 24 hours per day and that the entire surface is wet.

3.6.2 White-Burlap-Polyethylene Sheet

Wet entire exposed surface thoroughly with a fine spray of water, saturate burlap but do not have excessive water dripping off the burlap and then cover concrete with White-Burlap-Polyethylene Sheet, burlap side down. Lay sheets directly on concrete surface and overlap 12 inches. Make sheeting not less than 18 inches wider than concrete surface to be cured, and weight down on the edges and over the transverse laps to form closed joints. Repair or replace sheets when damaged during curing. Check daily to assure burlap has not lost all moisture. If moisture evaporates, resaturate burlap and re-place on pavement (limit re-saturation and re-placing to less than 10 minutes per sheet). Leave sheeting on concrete surface to be cured for at least 7 days.

### 3.6.3 Liquid Membrane-Forming Compound Curing

Apply compound immediately after surface loses its water sheen and has a dull appearance and before joints are sawed. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. Apply a total coverage for the two coats at least one gallon of undiluted compound per 200 square feet to produce a uniform, continuous, coherent film that will not check, crack, or peel and free from pinholes or other imperfections. The application of curing compound by hand-operated, mechanical powered pressure sprayers is permitted only on odd widths or shapes of slabs and on concrete surfaces exposed by the removal of forms. When the application is made by hand-operated sprayers, apply a second coat in a direction approximately at right angles to the direction of the first coat. Apply an additional coat of compound immediately to areas where film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after curing compound has been applied in the same manner.

### 3.6.4 Protection of Treated Surfaces

After the initial saw cut is complete and the slurry has been removed, respray the area with curing compound or restore the white burlap polyethylene sheet to maintain a continuous curing environment in the area of the sawn joints. Keep concrete surfaces to which liquid membrane-forming compounds have been applied free from vehicular traffic and other sources of abrasion for not less than 72 hours. Foot traffic is allowed after 24 hours for inspection purposes. Maintain continuity of coating for entire curing period and repair damage to coating immediately.

## 3.7 FIELD QUALITY CONTROL

### 3.7.1 Sampling

Collect samples of fresh concrete in accordance with ASTM C172/C172M during each working day as required to perform tests specified herein. Make test specimens in accordance with ASTM C31/C31M.

### 3.7.2 Consistency Tests

Perform concrete slump tests in accordance with ASTM C143/C143M. Take samples for slump determination from concrete during placement. Perform tests at the beginning of a concrete placement operation and for each batch (minimum) or every 20 cubic yards (maximum) of concrete to ensure that specification requirements are met. In addition, perform tests each time test beams are made.

### 3.7.3 Flexural Strength Tests

Test for flexural strength in accordance with ASTM C78/C78M. Fabricate and cure four test specimens in accordance with ASTM C31/C31M for each set of tests. Test two specimens at 7 days, and the other two at 28 days. Concrete strength will be considered satisfactory when the minimum of the 28-day test results equals or exceeds the specified 28-day flexural strength, and no individual strength test is less than the tolerance indicated on Table 1. If the ratio of the 7-day strength test to the specified 28-day strength is less than 65 percent, make necessary adjustments for conformance. Fabricate, cure and test a minimum of one set of four beams for each shift of concrete placement. Remove concrete

which is determined to be defective, based on the strength acceptance criteria therein, and replace with acceptable concrete.

3.7.4 Air Content Tests

Test air-entrained concrete for air content at the same frequency as specified for slump tests. Determine percentage of air in accordance with ASTM C231/C231M on samples taken during placement of concrete in forms.

3.7.5 Surface Testing

Use the straightedge method for transverse testing, for longitudinal testing where the length of each pavement lane is less than 200 feet, and at the ends of the paving limits for the project. Smoothness requirements do not apply over crowns, drainage structures, or similar penetrations. Maintain detailed notes of the testing results and submit a copy to the Government after each day's testing.

3.7.5.1 Straightedge Testing Method

Test the surface of the pavement with the straightedge to identify all surface irregularities exceeding the tolerances specified in Table 1. Test the entire area of the pavement in both a longitudinal and a transverse direction on parallel lines approximately 15 feet apart. Hold the straightedge in contact with the surface and move ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the 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.

3.7.5.2 Diamond Grinding

Those performing diamond grinding are required to have a minimum of three years experience in diamond grinding of rigid concrete pavements. 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 hardened concrete with an approved equipment after the concrete is at a minimum age of 14 days. Perform diamond grinding by sawing with an industrial diamond abrasive which is impregnated in the saw blades. 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 concrete 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 ft wide. Diamond grinding equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints is not permitted. The maximum area corrected by diamond grinding the surface of the hardened concrete is 10 percent of the total area of a day's production. The maximum depth of diamond grinding is 1/4 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 in Table 1. All areas in which diamond grinding has been

performed are subject to the thickness tolerances specified in Table 1.

3.7.6 Plan Grade Testing and Conformance

Within 5 days after each day's paving, test the finished surface of the pavement area by running lines of levels at intervals corresponding with every longitudinal and transverse joint to determine the elevation at each joint intersection. Record the results of this survey and submit a copy to the Government at the completion of the survey.

3.7.7 Edge Slump

Test the pavement surface to determine edge slump immediately after the concrete has hardened sufficiently to permit walking thereon. Perform testing with a minimum 12 foot straightedge to reveal irregularities exceeding the edge slump tolerance specified in Table 1. Determine the vertical edge slump at each free edge of each slipformed paving lane constructed. Place the straightedge transverse to the direction of paving and the end of the straightedge located at the edge of the paving lane. Record measurements at 5 to 10 foot spacings, as directed, commencing at the header where paving was started. Initially record measurements at 5 foot intervals in each lane. When no deficiencies are present after 5 measurements, the interval may be increased. The maximum interval is 10 feet. When any deficiencies exist, return the interval to 5 feet. In addition to the transverse edge slump determination above, at the same time, record the longitudinal surface smoothness of the joint on a continuous line 1 inch back from the joint line using the minimum 12 foot straightedge advanced one-half its length for each reading. Perform other tests of the exposed joint face to ensure that a uniform, true vertical joint face is attained. Properly reference all recorded measurements in accordance with paving lane identification and stationing, and submit a report within 24 hours after measurement is made. Identify areas requiring replacement within the report.

3.7.8 Test for Pavement Thickness

Take full depth cores of 4 inch diameter of concrete pavement every 5,000 square feet in accordance with ASTM C42/C42M. Measure thickness in accordance with ASTM C1542/C1542M. Record and submit testing, inspection, and evaluation of each core for surface paste, uniformity of aggregate distribution, segregation, voids, cracks, and depth of reinforcement or dowel (if present). Moisten the core with water to visibly expose the aggregate and take a minimum of three photographs of the sides of the core, rotating the core approximately 120 degrees between photographs. Include a ruler for scale in the photographs. Submit plan view of location for each core.

3.7.9 Reinforcement

Inspect reinforcement prior to installation to verify it is free of loose flaky rust, loose scale, oil, mud, or other objectionable material.

3.7.10 Dowels

Inspect dowel placement prior to placing concrete to verify that dowels are of the size indicated, and are spaced, aligned and painted and oiled as specified. Do not permit dowels to exceed the tolerances shown in paragraph: DOWEL BARS.

-- End of Section --

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SECTION 32 13 73.19

COMPRESSION CONCRETE PAVING JOINT SEALANT
**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 D412 | (2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension |
| 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 |

U.S. ARMY CORPS OF ENGINEERS (USACE)

| | |
|---|---|
| COE CRD-C 548 | (1988) Standard Specification for Jet-Fuel and Heat-Resistant Preformed Polychloroprene Elastomeric Joint Seals for Rigid Pavements |

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 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-03 Product Data

Equipment

Manufacturer's Instructions

SD-04, Samples

Compression Seals

SD-06 Test Reports

Test Requirements

1.3 QUALITY ASSURANCE

1.4 SAFETY

Do not place compression joint seals within 25 ft of liquid oxygen (LOX) equipment, LOX storage, or LOX piping.

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the jobsite for defects. Unload and store materials with a minimum of handling to avoid damage. Provide storage facilities that protect materials from weather and maintain materials within temperatures recommended by the manufacturer.

1.6 ENVIRONMENTAL REQUIREMENTS

Install materials only when the ambient temperature and the pavement temperature within the joint wall is at least 35 degrees F and rising. Do not permit sealant installation if moisture or foreign material is observed in the joint.

PART 2 PRODUCTS

2.1 SYSTEM EQUIPMENT

Provide machines, tools, and equipment, for use in the performance of the work required by this section, approved before the work is started, and maintained in satisfactory condition. Submit list of proposed machines, tools, and equipment to be used in the performance of joint sealing, including descriptive data, 45 days prior to use on the project.

2.1.1 Joint Cleaning Equipment

2.1.1.1 Concrete Saw

Provide a self-propelled power saw with water-cooled diamond saw blades for cutting joints to the depths and widths specified and for removing filler, existing old joint seal, or other material embedded in the joints or adhered to the joint faces.

2.1.1.2 Waterblasting Equipment

Include with the waterblasting equipment a trailer-mounted water tank, pumps, high-pressure hose, a wand with safety release cutoff controls, nozzle, and auxiliary water resupply equipment. Use a water tank and auxiliary water resupply equipment of sufficient capacity to permit continuous operations. Use pumps, hoses, wand, and nozzle of sufficient capacity to permit the cleaning of both walls of the joint and the pavement surface for a width of at least 1/2 in on either side of the joint. Use a pressure gauge mounted at the pump that shows the pressure in psi at which the equipment is operating.

2.1.2 Sealing Equipment

Install the compression seal by placing the compression seal to the prescribed depths and within the specified tolerances without cutting, nicking, twisting, or otherwise damaging the seal. Use equipment capable of placing the seal with not more than two percent longitudinal stretch or

compression of the seal during installation. Use a machine that is an automatic self-propelled joint seal application equipment and engine powered. Use a machine that includes a reservoir for the lubricant/adhesive, a device for conveying the lubricant/adhesive in the proper quantities to the sides of the compression seal or the sidewalls of the joints, a reel capable of holding one full spool of compression seal, and a power-driven apparatus for feeding the joint seal through a compression device and inserting the seal into the joint. Include a guide with the equipment to maintain the proper course along the joint being sealed. Operate the machine by an experienced operator.

Use a hand operated joint seal application equipment that is a two-axle, four-wheel machine that includes means for compressing and inserting the compression seal into the joint and a reel capable of holding one full spool of compression seal. Provide auxiliary equipment to coat both sides of the joint or the seal with lubricant/ adhesive just prior to the installation of the compression seal.

2.1.3 Test Requirements

Submit certified copies of test results, 30 days prior to use of material on the project. Sample, identify and test each lot of compression joint seal and lubricant/adhesive for conformance with the material specification.

a. A lot of compression seal consists of 1 day's production or 20,000 linear ft for each cross section, whichever is less. A lot of lubricant/adhesive consists of 1 day's production. Submit samples of the compression joint seal and lubricant/adhesive material to be tested by the Government. Do not permit use of material at the project prior to receipt of written notice that the materials meet the laboratory requirements.

b. The cost of testing the samples from each original lot supplied will be borne by the Government. If the samples fail to meet specification requirements, replace the materials represented by the sample and the new materials tested. Testing of the compression joint seal and lubricant/adhesive material is the responsibility of the Contractor. Perform testing in an approved, independent laboratory, and submit certified copies of the test reports for approval 30 days prior to the use of the materials at the jobsite.

c. Submit samples of each lot of material to be retained by the Government for possible future testing if the materials appear defective during or after application. Provide additional samples of materials, in sufficient quantity to be tested, upon request. Base final acceptance on conformance to the specified test requirements and the performance of the in-place materials with respect to slipping down the joint or material coming out of the joint..

2.2 COMPRESSION SEALS

Regardless of testing responsibility, submit 9 ft long samples of the materials, 60 days prior to use on the project. Provide printed directions from the manufacturer on recommended installation criteria with the samples plus the manufacturer's certification that the selected seal is recommended for the installation on this project. Use compression joint seal materials that are vulcanized elastomeric compound using polychloroprene as the only base polymer. Use material and manufactured

seal in accordance with ASTM D2628 and COE CRD-C 548 where jet fuel and/or heat blast resistance is required as tested by ASTM D412. Use a labryinth seal for the joint seal. The uncompressed depth of the face of the compression seal (that is to be bonded to the joint wall) is greater than the uncompressed width of the seal, except that for seals 1 in or greater in width, the depth need be only 1 in or greater. The actual width of the uncompressed seal for construction and contraction joints is 1 in and for expansion joints is 1.25 in. The tolerance on the seal is plus 1/8 in or minus 1/16 in.

## 2.3 LUBRICANT/ADHESIVE

Use a lubricant/adhesive for the compression elastomeric joint seal that is a one-component compound conforming to ASTM D2835.

# PART 3 EXECUTION

## 3.1 PREPARATION OF JOINTS

Immediately before installation of the compression joint seal, clean the joints to remove laitance, filler, existing sealer, foreign material and protrusions of hardened concrete from the sides and upper edges of the joint space to be sealed. Clean by sandblasting or waterblasting and extend along pavement surfaces at least 1/2 in on either side of the joint. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave free of debris and water. Demonstrate that the selected cleaning operation meets the cleanliness requirements resulting in joint sidewalls that are clean and dry and exhibit newly exposed concrete. Correct irregularities in the joint face which would prevent uniform contact between the joint seal and the joint face prior to the installation of the joint seal.

### 3.1.1 Sawing

Clean and open joints to the specified width and depth by sawing. Immediately following the sawing operation, clean the joint faces and opening using a water jet to remove saw cuttings or debris remaining on the faces or in the joint opening. Install compression seal within 3 calendar days of the time the joint cavity is sawed. Provide a depth of the joint cavity in accordance with manufacturer's instructions. Where installation procedures are required in accordance with the manufacturer's recommendations, submit printed copies of manufacturers' instructions, 30 days prior to use on the project. Center the saw cut for the joint seal cavity over the joint line. Provide the nominal width of the sawed joint seal cavity as follows:

a. If a nominal 1 in wide compression seal is provided, the nominal width of the saw cut is 9/16 in when the pavement temperature at the time of sawing is between 25 and 140 degrees F. If the pavement temperature at the time of sawing is above this range, decrease the nominal width of the saw cut 1/16 in. If the pavement temperature at the time of sawing is below this range, increase the nominal width of the saw cut 1/16 in.

b. Measure the pavement temperature in the presence of the Contracting Officer. Make measurement each day before commencing sawing and when the temperature appears to be varying from the allowable sawing range.

Use a tolerance of plus or minus 1/16 in for the actual width.

### 3.1.2 Waterblast Cleaning

Use a multiple pass waterblast technique until the surfaces are free of dust, dirt, curing compound, or residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete. After final cleaning and immediately prior to sealing, blow out the joints with compressed air and leave completely free of debris and water.

### 3.1.3 Rate of Progress

Limit sandblasting or waterblasting of joint faces to the length of joint that can be sealed during the same workday.

## 3.2 INSTALLATION OF THE COMPRESSION SEAL

Confirm a representative of the joint seal manufacturer is present at the trial joint installation to correct installation issues prior to full installation.

### 3.2.1 Time of Installation

Seal joints immediately within 3 calendar days of sawing the joint seal cavity and following concrete cure and the final cleaning of the joint walls. Provide open joints, ready for sealing that cannot be sealed under the specified conditions, with an approved temporary seal to prevent infiltration of foreign material. When rain interrupts the sealing operations, wash, clean with air pressure, and allow joints to dry prior to installing the lubricant/adhesive and compression seal.

### 3.2.2 Sequence of Installation

Seal longitudinal joints first, followed by transverse joints. Install seals in longitudinal joints so that transverse joint seals are intact from edge to edge of the pavement. Make intersections monolithic by use of joint seal adhesive and care in fitting the intersection parts together. Do not permit extender pieces of seal at intersections. Remove and replace seals falling short at the intersection with new seals at no additional cost to the Government. Require a poured sealant at the intersection where seals are required to change direction by more than 20 degrees. Provide poured sealant in accordance with compression seal manufacturer's instructions.

## 3.3 SEALING OF JOINTS

Cover the sides of the joint seal or the sides of the joint with a coating of lubricant/adhesive and the seal installed as specified. Coat butt joints and seal intersections with liberal applications of lubricant/adhesive. Immediately removed lubricat/adhesive spilled on the pavement to prevent setting on the pavement.

Provide the in-place joint seal will be in an upright position and free from twisting, distortion, and cuts. Adjustments will be made to the installation equipment and procedure, if the stretch exceeds 1 percent. Remove and replace seals exceeding 2 percent stretch. Place the joint seal at a uniform depth within the tolerances specified. Remove and replace in-place joint seals which fail to meet the specified requirements with new joint seal at no cost to the Government.

Place the compression joint seal to a depth of 1/4 in, plus or minus 1/8 in, below the pavement surface except when the joint is beveled or has a radius at the surface, or unless otherwise directed. For beveled joints or joints with a radius at the surface, install the compression joint seal at a depth of 1/8 in, plus or minus 1/8 in, below the bottom of the edge of the bevel or radius. Do not permit the seal to project above the surface of the pavement or above the edge of the bevel or radius.

Install the seal in the longest practicable lengths in longitudinal joints and cut at the joint intersections to provide continuous installation of the seal in the transverse joints. Permit the lubricant/adhesive in the longitudinal joints to set for 1 hour prior to cutting at the joint intersections to reduce the possibility of shrinkage. For transverse joints, the minimum length of the compression joint seal is the pavement width from edge to edge.

## 3.4 CLEAN-UP

Upon completion of the project, remove unused materials from the site, remove lubricant/adhesive on the pavement surface, and leave the pavement in clean condition.

## 3.5 QUALITY CONTROL PROVISIONS

### 3.5.1 Application Equipment

Inspect the application equipment to assure uniform application of lubricant/adhesive to the sides of the compression joint seal or the walls of the joint. If equipment causes cutting, twisting, nicking, excessive stretching or compressing of the seal, or improper application of the lubricant/adhesive, suspend the operation until causes of the deficiencies are determined and corrected.

### 3.5.2 Procedures

#### 3.5.2.1 Quality Control Inspection

Provide quality control provisions during the joint cleaning process to prevent or correct improper equipment and cleaning techniques that damage the concrete. Cleaned joints will be approved by the Government prior to installation of the lubricant/adhesive and compression joint seal.

#### 3.5.2.2 Conformance to Stretching and Compression Limitations

Determine conformance to stretching and compression limitations. Mark the top surface of the compression seal at 1 ft intervals in a manner clear and durable to enable length determinations of the seal. After installation, measure the distance between the marks on the seal. If the stretching or compression exceeds 2 percent, remove the seal and replace it with new joint at no additional cost to the Government. Remove the seal up to the last correct measurement. Inspect the seal a minimum of once per 100 ft of seal for compliance to the shrinkage or compression requirements. Make measurements at the same interval to determine conformance with depth and width of installation requirements. Remove and replace compression seal that is not in conformance with specification requirements with new joint seal at no additional cost to the Government.

3.5.2.3 Pavement Temperature

Determine the pavement temperature by placing a thermometer in the initial saw cut for the joint and record the reading. Pemrit the thermometer to remain in the joint for an adequate time to provide a stable control reading.

3.5.3 Acceptance

Inspect the joint sealing system (compression seal and lubricant/adhesive) for proper rate of cure and bonding to the concrete, cuts, twists, nicks and other deficiencies. Remove, waste and replace seals exhibiting defects prior to final acceptance of the project from the joint.

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SECTION 32 17 23

PAVEMENT MARKINGS
**08/16, CHG 5: 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 in the text by the basic designation only.

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 |

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 |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| FS TT-B-1325 | (Rev D; Notice 1; Notice 2 2017) Beads |

| | |
|---|---|
| | (Glass Spheres) Retro-Reflective (Metric) |
| FS TT-P-1952 | (2015; Rev F; Notice 1) Paint, Traffic and Airfield Markings, Waterborne |

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 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-03 Product Data

Surface Preparation Equipment List

Application Equipment List

Exterior Surface Preparation

Safety Data Sheets

SD-06 Test Reports

Waterborne Paint

Test Reports

SD-07 Certificates

Qualifications

Volatile Organic Compound, (VOC)

SD-08 Manufacturer's Instructions

Waterborne Paint

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.

1.3.3 Qualifications For Airfield Marking Personnel

Submit documentation of qualifications in resume format a minimum of 14 days before pavement marking work is to be performed showing personnel who will be performing the work have experience working on airfields, operating mobile self-powered marking, cleaning, and paint removal equipment and performing these tasks. Include with resume a list of references complete with points of contact and telephone numbers. Provide certification for pavement marking machine operator and Foreman demonstrating experience successfully completing a minimum of two airfield pavement marking projects of similar size and scope. Provide documentation demonstrating personnel have a minimum of four years of experience operating similar equipment and performing the same or similar work in similar environments, similar in size and scope of the planned project. The Contracting Officer reserves the right to require additional proof of competency or to reject proposed personnel.

1.4 DELIVERY AND STORAGE

Deliver paint materials, 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.

1.5.1.2 Weather Limitations for Removal of Pavement Markings on Roads and Automotive Parking Areas

Pavement surface must be free of snow, ice, or slush; with a surface temperature of at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting or grinding. Cease operation during thunderstorms, or during rainfall, except for waterblasting and removal of previously applied chemicals. Cease waterblasting where surface water accumulation alters the effectiveness of material removal.

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 Airfield Traffic Control

Coordinate performance of all work in the controlled zones of the airfield with the Contracting Officer and with the Flight Operations Officer or Airfield Manager. Neither equipment nor personnel can use any portion of the airfield without permission of these officers unless the runway is closed.

1.5.4 Airfield Radio Communication

No personnel or equipment will be allowed in the controlled zones of the airfield until radio contact has been made with the control tower and permission is granted by the control tower. Maintain contact with the control tower at all times during work in vicinity of the airfield. Notify the control tower when work is completed and all personnel, equipment and materials have been removed from all aircraft operating surfaces.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Surface Preparation and Paint Removal

2.1.1.1 Surface Preparation and Paint Removal Equipment for Airfield Pavements

Prepare all airfield surfaces and remove paint from airfield surfaces by waterblasting.

2.1.1.2 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.

2.1.1.2.1 Waterblasting Equipment

Use mobile waterblasting equipment capable of producing a pressurized stream of water that effectively removes paint from the pavement surface without significantly damaging the pavement. Provide equipment, tools, and machinery which are safe and in good working order at all times.

2.1.1.2.2 Grinding or Scarifying Equipment

Use equipment capable of removing surface contaminates, paint build-up, or extraneous markings from the pavement surface without leaving any residue. Clean the surface by hydro blast to remove surface contaminates and ash after a weed torch is used to remove paint.

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, 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 Airfield Marking

Provide self-propelled or mobile-drawn spraying machine for applying the paint for airfield pavements with an arrangement of atomizing nozzles capable of applying the specified line width in a single pass. Provide paint applicator with paint reservoirs or tanks of sufficient capacity and suitable gages to apply paint in accordance with requirements specified. Equip tanks with suitable mechanical agitators. Equip spray mechanism with quick-action valves conveniently located, and include necessary pressure regulators and gages in full view and reach of the operator. Install paint strainers in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns.

The paint applicator must be readily adaptable for attachment of a dispenser for the reflective media approved for use.

2.1.2.1.2.3 Hand Application

Provide spray guns for hand application of paint in areas where the mobile paint applicator cannot be used.

2.2 MATERIALS

Use waterborne paint for airfield markings. Use waterborne paint for roads. 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

FS TT-P-1952, Type II III.

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, adhesion of remaining coating and rate of cleaning. Perform a demonstration removal of pavement marking in an area designated by the Contracting Officer.

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, existing paint markings, 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.

b. Do not use shot blasting on airfield pavements due to the potential of Foreign Object Damage (FOD) to aircraft. Scrub affected areas, where oil or grease is present on old pavements to be marked, with several applications of trisodium phosphate solution or other approved detergent or degreaser and rinse thoroughly after each application. After cleaning oil-soaked areas, seal with shellac or primer recommended by the manufacturer to prevent bleeding through the new paint. Do not commence painting in any area until pavement surfaces are dry and clean.

### 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 Airfields

For non-reflectorized markings, apply paint conforming to FS TT-P-1952 Type II at a rate of 121 plus or minus 6 square feet per gallon Type III at a rate of 108 plus or minus 8 square feet per gallon

For reflectorized markings, apply paint and glass spheres at the following rates:

TABLE III

| Bead Type | Paint Type | Paint Application Rate | Bead Application Rate |
|---|---|---|---|
| Type I (Gradation A) | Type I, II, III | 121 plus or minus 6 Sq Ft/Gallon | 8 plus or minus 1 lb/gallon |
| Type III | Type I, II, III | 121 plus or minus 6 Sq Ft/Gallon | 10 plus or minus 1 lb/gallon |
| Type IV (Gradation A) | Type III | 76 plus or minus 12 Sq Ft/Gallon | 8 plus or minus 1 lb/gallon |
| Type IV (Gradation B) | Type III | 98 plus or minus 9 Sq Ft/Gallon | 8 plus or minus 1 lb/gallon |

3.3.1.1.2 Roads

Apply paint at a rate of 105 plus or minus 5 square feet per gallon. Apply FS TT-B-1325 Type I (Gradation A) beads at a rate of 7 plus or minus 0.5 pounds of glass spheres per gallon.

### 3.3.2 Cleanup and Waste Disposal

Keep the worksite clean and free of debris and waste from the removal and application operations. Immediately cleanup following removal operations in areas subject to aircraft traffic. Dispose of debris at approved sites.

## 3.4 FIELD QUALITY CONTROL

### 3.4.1 Sampling and Testing

As soon as the paint materials and reflective media are available for sampling, obtain by random selection from the sealed containers, four quart samples of each batch in the presence of the Contracting Officer. Two quarts will be for sampling and testing by the Contractor and two quarts will be for retention by the Government. 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.

Test samples by an approved laboratory. If a sample fails to meet specification, replace the material in the area represented by the samples and retest the replacement material as specified above. Submit certified copies of the test reports, prior to the use of the materials at the jobsite. Include in the report of test results a listing of any specification requirements not verified by the test laboratory. 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.

### 3.4.6 Retroreflective Markings

Collect and record readings for white and yellow retroreflective markings at the rate of one reading per 1000 linear feet. The minimum acceptable average for white markings is 200 millicandelas per square meter per lux (mcd/m2/lx) (measured with Retroreflectometer). The minimum acceptable average for yellow markings is 175 millicandelas per square meter per lux (mcd/m2/lx). Compute readings by averaging a minimum of 10 readings taken within the area at random locations. Re-mark areas not meeting the retroreflective requirements stated above.

### 3.4.7 Material Bond Verification and Operations Area Cleanup for Airfields

Vacuum sweep the aircraft operating area before it is opened for aircraft operations to preclude potential foreign object damaged to aircraft engines. Visually inspect the pavement markings and the material captured by the vacuum. Verify that no significant loss of reflective media has occurred to the pavement marking due to the vacuum cleaning.

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SEEDING
**08/17, CHG 1: 08/21**

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 C602 | (2020) Agricultural Liming Materials |
| 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 00 00 EARTHWORK 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" 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

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 Gypsum Sulfur Iron 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, gypsum, sulphur, iron, and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer Gypsum Sulfur Iron 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 90 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 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.

2.1.2 Planting Dates

| Planting Season | Planting Dates |
|---|---|
| Season 1 | April-July |
| Season 2 | August-November |

2.1.3 Seed Purity

| Common Name | Minimum Percent Pure Seed | Minimum Percent Germination and Hard Seed | Origin |
|---|---|---|---|
| Crested Wheatgrass | 39.85 | 97 | WY |
| Perennial Ryegrass, Clubhouse | 29.7 | 90 | OR |
| Hard Fescue, VNS | 19.4 | 85 | OR |
| Annual Ryegrass, Gulf | 9.98 | 90 | OR |

2.1.4 Seed Mixture by Weight

Proportion seed mixtures by weight. Temporary seeding must later be replaced by Season 1 plantings for a permanent stand of grass. The same requirements of turf establishment for Season 1 apply for temporary seeding.

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 00 00 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 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, 3/4 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. Other components must conform to the following limits:

| | |
|---|---|
| Silt | 25-50 percent |
| Clay | 10-30 percent |
| Sand | 20-35 percent |
| pH | 5.5 to 7.0 |
| Soluble Salts | 600 ppm maximum |

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

Commercial grade burnt 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 Sand

Clean and free of materials harmful to plants.

2.3.6 Perlite

Horticultural grade.

2.3.7 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:

2.3.7.1 Particle Size

Minimum percent by weight passing:

| | |
|---|---|
| No. 4 mesh screen | 95 |
| No. 8 mesh screen | 80 |

2.3.7.2 Nitrogen Content

Minimum percent based on dry weight:

| | |
|---|---|
| Fir Sawdust | 0.7 |
| Fir or Pine Bark | 1.0 |

2.3.8 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.

2.3.9 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

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

2 percent available nitrogen
14 percent available phosphorus
14 percent available potassium
Trace percent sulfur
Trace percent iron

2.5 MULCH

Mulch must be free from noxious weeds, mold, and other deleterious materials.

2.5.1 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 8.2. 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 nettings, designed to degrade within 12 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 to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters, 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 3/4 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:

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 600 pounds per acre.

## 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, or 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 broadcasted and drop seeding.

#### 3.2.2.1 Broadcast and Drop Seeding

Seed must be uniformly broadcast at the rate of 56 pounds per acre. Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

### 3.2.3 Mulching

#### 3.2.3.1 Hay or Straw Mulch

Hay or straw mulch must be spread uniformly at the rate of 2 tons per acre. Mulch must be spread by hand, blower-type mulch spreader, or other approved method. Mulching must be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch must not be bunched or clumped. Sunlight must not be completely excluded from penetrating to the ground surface. All areas installed with seed must be mulched on the same day as the seeding. Mulch must be anchored immediately following spreading.

### 3.2.4 Erosion Control Material

Install in accordance with manufacturer's instructions, where indicated or as directed by the Contracting Officer.

### 3.2.5 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.

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SANITARY SEWERAGE

**05/18**

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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 C104/A21.4 | (2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water |
| AWWA C111/A21.11 | (2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings |

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 A746 | (2018) Standard Specification for Ductile Iron Gravity Sewer Pipe |
| ASTM C94/C94M | (2021b) Standard Specification for Ready-Mixed Concrete |
| ASTM C150/C150M | (2022) Standard Specification for Portland Cement |
| ASTM C270 | (2019a; E 2019) Standard Specification for Mortar for Unit Masonry |
| 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 C478M | (2018) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric) |
| ASTM C972 | (2000; R 2011) Compression-Recovery of Tape Sealant |

| | |
|---|---|
| ASTM C1244 | (2020) Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill |
| ASTM C1644 | (2006; R 2017) Standard Specification for Resilient Connectors Between Reinforced Concrete On-Site Wastewater Tanks and Pipes |
| 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 D2321 | (2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications |
| ASTM D3034 | (2016) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings |
| ASTM D3212 | (2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals |
| ASTM D4101 | (2017) Standard Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials |
| ASTM F477 | (2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe |
| ASTM F949 | (2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings |

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

| | |
|---|---|
| 29 CFR 1910.27 | (Nov 2016) Scaffolds and Roope Descent Systems |

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

| | |
|---|---|
| UBPPA UNI-B-6 | (1998) Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe |

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

Contractor's License

SD-02 Shop Drawings

Installation Drawings; G-AE

SD-03 Product Data

Precast Concrete Manholes

Frames, Covers, and Gratings

Gravity Pipe

SD-06 Test Reports

Precast Concrete Sewer Manhole Test

Hydrostatic Sewer Test

Infiltration Tests And Exfiltration Tests

Negative Air Pressure Test

Low-Pressure Air Tests

SD-07 Certificates

Portland Cement

Gaskets

Pre-Installation Inspection Request

Post-Installation Inspection

## 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.

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. 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 building connections of polyvinyl chloride (PVC) plastic pipe. Provide new and modify existing 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.

2.2 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 Ductile Iron Gravity Sewer Pipe and Associated Fittings

2.2.1.1.1 Ductile Iron Gravity Pipe and Fittings

Provide ductile iron pipe conforming to ASTM A746 with cement-mortar lining in conforming to AWWA C104/A21.4, Pressure Class 350 psi. Provide push-on joints conforming to AWWA C111/A21.11.

2.2.1.2 PVC Gravity Sewer Piping

2.2.1.2.1 PVC Gravity Pipe and Fittings

ASTM D3034, SDR 35, or ASTM F949 with ends suitable for elastomeric gasket joints.

2.2.1.2.2 PVC Gravity Joints and Jointing Material

Provide joints conforming to ASTM D3212. Gaskets are to conform to ASTM F477.

2.2.2 Cement Mortar

Provide cement mortar conforming to ASTM C270, Type M with Type II cement.

2.2.3 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.

2.2.4 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.

2.2.5 Precast Concrete Manholes

Provide precast concrete manholes, risers, base sections, and tops conforming to ASTM C478.

2.2.6 Gaskets and Connectors

Provide gaskets for joints between manhole sections conforming to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole are to conform to ASTM C1644.

2.2.7 External Preformed Rubber Joint Seals

An external preformed rubber joint seal is an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" are to be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal is to be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit is to consist of a top and bottom section and have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic is to be a non-hardening butyl rubber sealant and seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections are to cover up to two more adjusting rings. Properties and values are listed in the following table:

| Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals | | | | |
|---|---|---|---|---|
| Physical Properties | Test Methods | EPDM | Neoprene | Butyl Mastic |
| Tensile, psi | ASTM D412 | 1840 | 2195 | -- |
| Elongation, percent | ASTM D412 | 553 | 295 | 350 |

| Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals | | | | |
|---|---|---|---|---|
| Physical Properties | Test Methods | EPDM | Neoprene | Butyl Mastic |
| Tear Resistance, ppi | ASTM D624 (Die B) | 280 | 160 | -- |
| Rebound, percent, 5 minutes | ASTM C972 (mod.) | -- | -- | 11 |
| Rebound, percent, 2 hours | ASTM C972 | -- | -- | 12 |

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, cast ductile iron, ASTM A536, Grade 65-45-12, or reinforced concrete, ASTM C478 ASTM C478M. Frames and covers are to be circular with 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 with a plastic or rubber coating pressure-molded to the steel is to 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.

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 Connections to Existing Lines

Obtain approval from the Contracting Officer before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.2.2 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."

3.2.2.1 Location

Terminate the work covered by this section at a point approximately 5 feet from the building.

3.2.2.1.1 Sanitary Piping Installation Parallel with Water Line

3.2.2.1.1.1 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.

3.2.2.1.1.2 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.

3.2.2.1.2 Installation of Sanitary Piping Crossing a Water Line

3.2.2.1.2.1 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.

3.2.2.1.2.2 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.

3.2.2.1.3 Sanitary Sewer Manholes

No water piping shall pass through or come in contact with any part of a sanitary sewer manhole.

3.2.2.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.2.2.3 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 nonpressure 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.

3.2.3 Special Requirements

3.2.3.1 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.

3.2.4 Manhole Construction

Construct base slab of precast concrete base sections. Make inverts 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. 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. 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

3.2.6 Installations of Wye Branches

Install wye branches in an existing sewer using a method which does not damage the integrity of the existing sewer. Do not cutinto piping for connections except when approved by the Contracting Officer. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, support on a concrete cradle as directed by the Contracting Officer. Provide and install concrete required because of conditions resulting from faulty construction methods or negligence without any additional cost to the Government. Do not damage the existing sewer when installing wye branches in an existing sewer.

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 with a minimum test pressure of 30psi.

3.3.1.2 Leakage Tests for Nonpressure Lines

Test lines for leakage by either infiltration tests and exfiltration tests, negative air pressure tests or by low-pressure air 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 Infiltration Tests and Exfiltration Tests

3.3.1.2.2 Negative Air Pressure Test

3.3.1.2.2.1 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.

3.3.1.2.3 Low-Pressure Air Tests

3.3.1.2.3.1 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.

3.3.2 Inspection

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; the light must show a practically full circle of light through the pipeline when viewed from the adjoining end of line.

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.

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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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

| | |
|---|---|
| AASHTO HB-17 | (2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges |

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 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 B800 | (2005; R 2021) Standard Specification for 8000 Series Aluminum Alloy Wire for Electrical Purposes-Annealed and Intermediate Tempers |
| ASTM B801 | (2018) Standard Specification for Concentric-Lay-Stranded Conductors of 8000 Series Aluminum Alloy for Subsequent Covering or Insulation |

| | |
|---|---|
| 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 2019) Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants |
| ASTM F512 | (2019) Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation |

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 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 C2 | (2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code |
| IEEE Stds Dictionary | (2009) IEEE Standards Dictionary: Glossary of Terms & Definitions |

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

| | |
|---|---|
| NETA ATS | (2021) 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 |
| 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 6 & 8 | (2020) Standard for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installations |
| 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; TIA 22-1; ERTA 1 2022) National Electrical Code |

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 Apr 2022) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances |
| UL 467 | (2022) 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 514B | (2012; Reprint May 2020) Conduit, Tubing and Cable Fittings |
| UL 651 | (2011; Reprint May 2022) 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 Apr 2022) UL Standard for Safety Electrical Intermediate Metal Conduit -- Steel |

## 1.2 SYSTEM DESCRIPTION

Items provided under this section must be specifically suitable for the following service conditions. Seismic details must conform to UFC 3-301-01, "Structural Engineering" and Sections 13 48 73 BRACING FOR MISCELLANEOUS EQUIPMENT.

a. Altitude 3300 feet.

b. Frequency 60 Hz

c. Seismic Parameters Risk Category II

## 1.3 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

## 1.4 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.

1.5 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

Aluminum Conductors

Submit modified drawings and engineering calculations associated with design changes required for use of aluminum conductors.

Precast Underground Structures

SD-03 Product Data

Medium Voltage Cable

Medium Voltage Cable Joints

Medium Voltage Cable Terminations

Precast Concrete Structures

Sealing Material

Pulling-In Irons

Manhole Frames and Covers

Handhole Frames and Covers

Transformer Box Pad

Cable Supports (racks, arms and insulators)

Protective Devices and Coordination Study; G-RO

Submit the study with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed will be based on recommendations of this study. The Government will not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered or procured prior to approval of the study.

SD-06 Test Reports

Medium Voltage Cable Qualification and Production Tests

Field Acceptance Checks and Tests

Arc-proofing Test for cable fireproofing tape

Cable Installation Plan and Procedure

SD-07 Certificates

Cable splicer/terminator

Cable Installer Qualifications

1.6 QUALITY ASSURANCE

1.6.1 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

1.6.2 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). 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.

1.6.3 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.

1.6.4 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.

1.6.5 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 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.

1.6.5.1 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 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.

2.1.2 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-80.

2.1.4 Plastic Duct for Concrete Encasement

Provide Type EB-20 per UL 651, ASTM F512, and NEMA TC 6 & 8.

2.1.5 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.

2.1.6 Fittings

2.1.6.1 Metal Fittings

UL 514B.

2.1.6.2 PVC Conduit Fittings

UL 514B, UL 651.

2.1.6.3 PVC Duct Fittings

NEMA TC 9.

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. Conductors No. 4 AWG and larger may be either copper or aluminum, at the Contractor's option. Do not substitute aluminum for copper if the equivalent aluminum conductor size would exceed 500 kcmil. When the Contractor chooses to use aluminum for conductors No. 4 AWG and larger, the Contractor must: increase the conductor size to have the same ampacity as the copper size indicated; increase the conduit and pull box sizes to accommodate the larger size aluminum conductors in accordance with NFPA 70; ensure that the pulling tension rating of the aluminum conductor is sufficient; relocate equipment, modify equipment terminations, resize equipment, and resolve to the satisfaction of the Contracting Officer problems that are direct results of the use of aluminum conductors in lieu of 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 XHHW or RHW conforming to UL 44. Copper

conductors must be annealed copper complying with ASTM B3 and ASTM B8. Aluminum conductors must be Type AA-8000 aluminum conductors complying with ASTM B800 and ASTM B801, and must be of an aluminum alloy listed or labeled by UL as "component aluminum-wire stock (conductor material). Type 1350 is not acceptable. Intermixing of copper and aluminum conductors in the same raceway is not permitted.

2.2.3 Jackets

Provide multiconductor cables with 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.

Color code conductors. 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. Properly identify control circuit terminations. 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 may be white with a different colored (not green) stripe for each. Color of ungrounded conductors in different voltage systems are 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. 120/240 volt, single phase: Black and red

2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS

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.

b. For use with aluminum conductors: UL 486A-486B. For connecting aluminum to copper, connectors must be the circumferentially compressed, metallurgically bonded type.

## 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 applications. Cable must be rated 15 kV with 133 percent insulation level.

### 2.5.2 Conductor Material

Provide concentric-lay-stranded, Class B conductors. Provide aluminum alloy Type AA-8000 aluminum conductors complying with ASTM B800 and ASTM B801.

### 2.5.3 Insulation

Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of ANSI/NEMA WC 71/ICEA S-96-659 and AEIC CS8.

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 aluminum, 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 to1/3 of the phase conductor ampacity rating.

2.5.6 Jackets

Provide cables with a PVC jacket. Provide PVC jackets with a separator that prevents contact with underlying semiconducting insulating shield.

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. Provide terminations, where required, with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, or armor. Provide terminations 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 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). Design termination for installation in low or highly contaminated indoor and outdoor locations and must resist ultraviolet rays and oxidative decomposition.

2.6.2 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. Design termination for installation in low or highly contaminated indoor or outdoor locations.

## 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.

### 2.7.1 Heat-Shrinkable Joint

Consists of a uniform cross-section heat-shrinkable polymeric construction with a linear stress relief system, a high dielectric strength insulating material, and an integrally bonded outer conductor layer for shielding. Replace original cable jacket with a heavy-wall heat-shrinkable sleeve with hot-melt adhesive coating.

### 2.7.2 Cold-Shrink Rubber-Type Joint

Joint must be of a cold shrink design that does not require any heat source for its installation. Splice insulation and jacket must be of a one-piece factory formed cold shrink sleeve made of black EPDM rubber. Splice should be packaged three splices per kit, including complete installation instructions.

## 2.8 TAPE

### 2.8.1 Insulating Tape

UL 510, plastic insulating tape, capable of performing in a continuous temperature environment of 80 degrees C.

### 2.8.2 Buried Warning and Identification Tape

Provide detectable tape in accordance with Section 31 00 00 EARTHWORK.

### 2.8.3 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.

## 2.9 PULL ROPE

Plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

## 2.10 GROUNDING AND BONDING

### 2.10.1 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.

2.10.2 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.

2.11 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.

2.12 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.

2.12.1 Cast-In-Place Concrete Structures

Concrete must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.12.2 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.

2.12.2.1 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.

2.12.2.2 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 (phi) = 30 degrees

b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated) = 130 pcf

c. Coefficient of Lateral Earth Pressure (Ka) = 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, or aircraft) traffic to be encountered. The minimum design vertical load must be for H20 highway loading per AASHTO HB-17.

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.

2.12.2.3 Construction

Provide a uniform thickness for structure top, bottom, and wall 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.

2.12.2.4 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.

2.12.3 Manhole Frames and Covers

Provide cast iron frames and 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.

2.12.4 Handhole Frames and Covers

Frames and covers of steel must be welded by qualified welders in accordance with standard commercial practice. Provide rolled-steel floor plate covers 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.

2.12.5 Brick for Manhole Collar

Provide sewer and manhole brick conforming to ASTM C32, Grade MS.

2.13 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

Zinc coat the metal portion of racks and arms after fabrication.

2.13.1 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. Space slots for mounting cable rack arms at 8 inch intervals.

2.13.2 Rack Arms

Cable rack arms must be steel or malleable iron or 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.

2.13.3 Insulators

Insulators for metal rack arms must be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.14 CABLE TAGS IN MANHOLES

Provide polyethylene tags for each power cable located in manholes. Do not provide handwritten letters. The first position on the power cable

tag denotes the voltage. The second through sixth positions on the tag identifies the circuit. The next to last position denotes the phase of the circuit and include the Greek "phi" symbol. The last position denotes 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.

2.14.1 Polyethylene Cable Tags

Provide tags of polyethylene having 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, having a minimum loop tensile strength of 175 pounds and 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.

2.15 PROTECTIVE DEVICES AND COORDINATION

Provide protective devices and coordination as specified in Section 26 28 01.00 10 COORDINATED POWER SYSTEM PROTECTION.

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. Direct the arc 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). Test each sample assembly 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.

2.17 TRANSFORMER BOX PAD

Provide a fiberglass box pad. The box pad must be UV and weather

resistant. It must be selected to accommodate the size and weight of the transformer selected per Section 26 12 19.10 Three-Phase, Liquid-Filled Pad-Mounted Transformers.

## 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 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 a point 5 feet outside the building and projections thereof, except that conductors must be continuous to the terminating point indicated. Coordinate connections of the feeders to the service entrance equipment with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide PVC, Type EPC-40 conduit from the supply equipment to a point 5 feet outside the building and projections thereof. Protect ends of underground conduit with plastic plugs until connections are made.

Encase the underground portion of the conduit in a concrete envelope and bury as specified for underground duct with concrete encasement.

## 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. 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. 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

Construct walls on a footing of cast-in-place concrete except that precast concrete base sections may be used for precast concrete manhole risers.

### 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, locate the irons a minimum of 6 inches from the edge of the sump, and in the walls, locate the irons 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. Hot-dip galvanize irons 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 are 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;" and 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

Clean cast-iron frames and covers not buried in concrete or masonry of mortar, rust, grease, dirt and other deleterious materials, and coat with bituminous paint.

## 3.6 UNDERGROUND CONDUIT AND DUCT SYSTEMS

### 3.6.1 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 above 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 3 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. Terminate all PVC conduit end points in utility holes, switching cabinets, transform handholes and buildings with end bells. The bell end of the conduits that enter manholes and handholes must be flush with the wall.

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 allowed for use in field manufactured longsweep bend: 30 degrees.

### 3.6.2 Treatment

Keep ducts clean of concrete, dirt, or foreign substances during construction. Make field cuts requiring tapers with proper tools and match factory tapers. Use a coupling recommended by the duct manufacturer whenever an existing duct is connected to a duct of different material or shape. Store ducts to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Thoroughly clean ducts before being laid. Store plastic ducts on a flat surface and protected from the direct rays of the sun.

### 3.6.3 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.

### 3.6.4 Jacking and Drilling Under Roads and Structures

Conduits to be installed under existing paved areas which are not to be disturbed, and under roads and railroad tracks, must be zinc-coated, rigid steel, jacked into place. Where ducts are jacked under existing pavement, install rigid steel conduit because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. For

crossings of existing railroads and airfield pavements greater than 50 feet in length, the predrilling method or the jack-and-sleeve method will be used. Separators or spacing blocks must be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 4 feet on centers.

3.6.5 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.

3.6.6 Conduit Plugs and Pull Rope

Provide new conduit indicated as being unused or empty 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.

3.6.7 Conduit and Duct Without Concrete Encasement

Depths to top of the conduit must be not less than 24 inches below finished grade. Provide not less than 3 inches clearance from the conduit to each side of the trench. Grade bottom of trench smooth; where rock, soft spots, or sharp-edged materials are encountered, excavate the bottom for an additional 3 inches, fill and tamp level with original bottom with sand or earth free from particles, that would be retained on a 1/4 inch sieve. The first 6 inch layer of backfill cover must be sand compacted as previously specified. The rest of the excavation must be backfilled and compacted in 3 to 6 inch layers. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.6.7.1 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. Extend concrete encasement 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.

3.6.8 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 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, prevent floating during concrete pouring by driving

reinforcing rods adjacent to duct spacer assemblies and attaching the rods to the spacer assembly.

3.6.8.1 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.

3.6.8.2 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 extend into 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.

3.6.8.3 Connections to Existing Concrete Pads

For duct bank connections to concrete pads, break an opening in the pad out to the dimensions required and preserve steel in pad. Cut the steel and extend into the duct bank envelope. Chip out the opening in the pad to form a key for the duct bank envelope.

3.6.8.4 Connections to Existing Ducts

Where connections to existing duct banks are indicated, excavate the banks to the maximum depth necessary. Cut off the banks and remove loose concrete from the conduits before new concrete-encased ducts are installed. Provide a reinforced concrete collar, poured monolithically with the new duct bank, to take the shear at the joint of the duct banks.

3.6.8.5 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.

3.6.9 Duct Sealing

Seal all electrical penetrations for radon mitigation, maintaining integrity of the vapor barrier, and to prevent infiltration of air, insects, and vermin.

3.7 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 or wire 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.

### 3.7.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

## 3.8 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.

### 3.8.1 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.

## 3.9 CONDUCTORS INSTALLED IN PARALLEL

Group conductors such that each conduit of a parallel run contains one Phase A conductor, one Phase B conductor, one Phase C conductor, and one neutral conductor.

## 3.10 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.

### 3.10.1 Terminating Aluminum Conductors

a. Use particular care in making up joints and terminations. Remove surface oxides by cleaning with a wire brush or emery cloth. Apply joint compound to conductors, and use UL-listed solid aluminum connectors for connecting aluminum conductors. When connecting aluminum to copper conductors, use connectors specifically designed for this purpose.

b. Terminate aluminum conductors to copper bus either by: (1) in line splicing a copper pigtail to the aluminum conductor (copper pigtail must have a ampacity at least that of the aluminum conductor); or (2) using a circumferential compression type, aluminum bodied terminal lug UL listed for AL/CU and steel Belleville spring washers, flat washers, bolts, and nuts. Belleville spring washers must be cadmium-plated hardened steel. Install the Belleville spring washers with the crown up toward the nut or bolt head, with the concave side of the Belleville bearing on a heavy-duty, wide series flat washer of larger diameter than the Belleville. Tighten nuts sufficient to flatten Belleville and leave in that position. Lubricate hardware with joint compound prior to making connection. Wire brush and apply joint compound to conductor prior to inserting in lug.

c. Terminate aluminum conductors to aluminum bus by using all-aluminum nuts, bolts, washers, and lugs. Wire brush and apply inhibiting compound to conductor prior to inserting in lug. Lubricate hardware with joint compound prior to making connection; if bus contact surface is unplated, scratch-brush and coat with joint compound (without grit).

## 3.11 MEDIUM VOLTAGE CABLE TERMINATIONS

Make terminations in accordance with the written instruction of the termination kit manufacturer.

## 3.12 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.

### 3.12.1 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.

## 3.13 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.

## 3.14 FIREPROOFING OF CABLES IN UNDERGROUND STRUCTURES

Fireproof (arc proof) wire and cables which will carry current at 2200 volts or more in underground structures.

3.14.1 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 GROUNDING SYSTEMS

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 25 ohms.

3.15.1 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, provide an additional ground rod 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.

3.15.2 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.

3.15.3 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. Ground metallic frames and covers of handholes and pull boxes with a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.15.4 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.

3.15.5 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 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 00 00 EARTHWORK.

### 3.16.1 Reconditioning of Surfaces

#### 3.16.1.1 Unpaved Surfaces

Restore to their original elevation and condition unpaved surfaces disturbed during installation of duct . 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.

## 3.17 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

### 3.17.1 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. Place slab 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.

### 3.17.2 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.

## 3.18 FIELD QUALITY CONTROL

### 3.18.1 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.

3.18.1.1 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) |

3.18.1.2 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.

3.18.1.3 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.

3.18.2 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.

.... -- End of Section --

# APPENDIX A – GEOTECHNICAL EVALUATION REPORT (FOR INFORMATION ONLY)

## B-21: WEAPONS LOADER TRAINING (WLT) FACILITY
## PNFXBM23180 (FY23)

## ELLSWORTH AFB, SOUTH DAKOTA

PREPARED BY:
U.S. Army Corps of Engineers, Omaha District

*BUILDING STRONG*

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FMG ENGINEERING 3700 Sturgis Road • Rapid City, SD 55702 • **fmgengineering.com** • 605-342-4105

November 18, 2022

**Mr. Bryan Dyson, AIA**
Jacobs
bryan.dyson@jacobs.com

**Re: Geotechnical Evaluation**
**Weapons Loader Training Facility**
**EAFB, SD**

Dear Mr. Dyson:

As requested, we have performed a geotechnical evaluation for the referenced project. The purpose of this evaluation was to identify the subsurface characteristics, provide geotechnical design parameters for foundation design.

The findings and recommendations of this report were prepared in accordance with generally accepted professional engineering principles and practices. We make no other warranty, either express or implied.

We trust this information to be sufficient. If you have any questions or desire any additional information, please do not hesitate to contact us.

Respectfully submitted,

**FMG Engineering**

**John Lucas, P.E.** **Alex Fisher, P.E.**

**Enclosures**

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# Geotechnical Evaluation

**for**

**Weapons Loader Training Facility**
**EAFB, South Dakota**

**November 18, 2022**

*Prepared for*
**Jacobs**
**Mr. Bryan Dyson, AIA**
**bryan.dyson@jacobs.com**

**FMG Project No. 221204.00**

**Civil Engineering**
**Geotechnical Engineering**
**Materials Testing Laboratory**
**Land Surveying**
**Environmental Services**
**Water Resources**

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# 1. INTRODUCTION

The existing northeast half of Pride Hangar at Ellsworth Air Force Base (EAFB) will be converted to a Weapons Loader Training Facility. The Pride Hangar is a large, free-span concrete arch structure with a footprint on the order of 120,000 square feet.

The new mission for the hangar will include weapons training facility and supporting functions and services. New structures such as framing and walls are proposed which will require additional foundation elements.

FMG Engineering (FMG) was retained by Jacobs to perform a geotechnical evaluation of the of the project site to identify the subsurface conditions, suggest suitable foundation systems for the new structures and provide geotechnical design parameters. If proposed construction or locations differ significantly from that described above or elsewhere described in this report, our office should be contacted to re-evaluate the recommendations contained in this report. Figure 1 illustrate the specific locations of our field explorations.

This report presents our geotechnical evaluation of the project site. Our evaluation included the following general scope of activities:

1. A general review of the regional geology, and related site characteristics.

2. Field exploratory borings, sampling, and testing at representative locations to determine the depth, thickness, orientation, engineering characteristics, and composition of the subsurface conditions.

3. Laboratory tests to identify the soil types, classifications, and engineering properties of the subsurface materials encountered at the site.

4. An analysis of the data obtained, and determination of suitable geotechnical design parameters and other such recommendations as considered applicable to satisfactory design and performance.

Field and laboratory tests were accomplished in accordance with current UFC, ASTM, AASHTO, Army Corps of Engineers, and IEEE procedures, where applicable. The evaluation was accomplished under the direction of a registered professional engineer. This report presents the geotechnical engineering evaluation with recommendations for foundation and pavement design. We have also included a discussion of our field sampling and testing procedures, laboratory analyses, and site conditions.

## 2. FIELD SAMPLING AND TESTING PROCEDURES

A total of two (2) boreholes were drilled at the locations shown on Figure 1 to identify the subsurface characteristics and obtain soil samples for laboratory testing. The boreholes were observed by the FMG field geologist. Field sampling and testing procedures were conducted in general accordance with ASTM D420.

The boreholes were drilled with a track-mounted Diedrich D-70 drill rig and hollow-stem auger. The existing hangar floor slab was cored with a 12-inch diameter, diamond-tipped core barrel to allow the advancement of the geotechnical borehole. After removal of the cores, drilling proceeded without complication at each borehole location.

The number of boreholes and the location were selected by Jacobs and were adjusted in the field as necessary by FMG to avoid existing utilities and the hangar structure tendons. If, during subsequent planning, the project locations change significantly from those described in this report and shown on Figure 1, we recommend drilling additional boreholes to verify soil conditions in unexplored areas. The borehole locations are summarized in Appendix A.

Borehole field testing consisted of obtaining standard penetration test (SPT) samples from various depths in the boreholes. The SPT testing was performed to identify the relative field strengths of the subsurface materials and to obtain samples for laboratory analyses.

The SPT testing was performed with an auto hammer with an Energy Transfer Ratio of 93.8% and an $N_{60}$ Correction Factor of 1.56. Due to the presence of coarse gravel and cobble within the gravel layers at the site, SPT values within gravel layers may be artificially inflated locally.

Geologic logs of the boreholes were maintained by a field geologist and the materials were classified in accordance with ASTM: D 2487-90 and D 2488-90 (Unified Soil Classification System), Figure 3. The geologic logs include the general drilling method data, depths of major changes in the character of the subsurface materials, visual description of the materials, sample locations, standard penetration data and locations, and groundwater data. In addition, the geologic logs also include the data from certain laboratory classification and physical property analyses. The geologic logs are presented as Appendix A.

The geologic logs and related information depict only the conditions and materials encountered at the specific borehole location and at the time designated on the logs. Soil conditions at other locations may be different from those encountered at the borehole locations. Also, the passage of time may produce a changed soil condition. We have extrapolated the data obtained from the boreholes and our conclusions and recommendations assume that the materials encountered are representative of the soils that exist over the site. Anomalies may be present around the boreholes.

# 3. LABORATORY ANALYSIS

The laboratory analysis was directed towards the determination of soil types drilled on the site and their engineering properties. The laboratory testing was performed in general conformance with current ASTM and AASHTO procedures, where applicable. The laboratory testing results are provided in Appendix B, and on the borehole logs where applicable.

FMG holds an AASHTO laboratory accreditation and a USACE Laboratory Validation. For reference, certificates of these accreditations and validations are also provided in Appendix B.

The laboratory testing results were observed to be generally within expected ranges for the soil types as logged in the field and no outliers or questionable testing results were observed. The results were also reviewed with respect recent geotechnical testing performed by FMG at the Pride Hangar, Wash Hangar, LO Hangar, RF Hangar, and the Phase Hangar Facility, which are all located in relatively close proximity to the project site. The soil classifications, and strength testing were all found to be consistent the findings at these adjacent projects, allowing a high degree of confidence in the laboratory testing.

## 3.1 ATTERBERG LIMITS

The Atterberg limits were determined for select samples. These tests allow for more detailed classification of soils and provide information relative to the expected engineering characteristics and properties. (ASTM D4318-05)

## 3.2 GRAIN SIZE ANALYSIS DATA

Standard grain size analysis determinations were performed to determine the grain size distribution and assist in the determination of the physical characteristics and engineering properties of the subsurface materials. (ASTM D422-63(2007))

### 3.3 DIRECT SHEAR TEST

The strength characteristics of the on-site materials were determined with direct shear testing of samples that were obtained from the site. The direct shear test results provide indications of the soil's internal angle of friction ($\phi$) in degrees ($^o$). (ASTM 3080)

### 3.4 SOIL CHEMICAL ANALYSIS

To assess corrosivity to concrete and steel, select soil samples were tested for pH, Chlorides, Soluble Sulfates, Redox Potential and Sulfides. The results of the chemical analysis are presented in Appendix B and discussed in Section 5.10. (ASTM G200-09, EPA SW846 9045C, SM 4500)

### 3.5 SOIL ELECTRICAL RESISTIVITY

The electrical resistivity of representative samples of site soils was determined via the 4-pin laboratory soil box method and is presented in ohms-cm. The results of the resistivity testing are provided in Appendix B. (ASTM G57)

### 3.6 SAMPLE STORAGE

The soil samples obtained during this evaluation will not be stored. If the client wishes to receive the samples arrangements should be made; otherwise, the samples will be discarded.

# 4. SITE CONDITIONS

The existing Pride Hangar is a free-span, concrete-arch structure with a footprint on the order of 120,000 square feet and telescoping hangar doors at the southwest and northeast sides. Constructed in 1949, the hangar has a large open space of approximately 92,000 square feet and a concrete floor slab with a thickness of approximately 19.5 to 22 inches. The balance of the overall footprint is occupied by mezzanines on the northwest and southeast sides of the building, which house storage space, office space, locker rooms and restrooms. The hangar has a finished floor elevation of approximately 3217.02 and is currently utilized as recreational facility, housing a running track, artificial turf, and exercise equipment.

The exterior of the hangar is surrounded by asphalt paved areas, generally vehicle parking and driveways on the northwest, northeast and southeast sides. The southwest side of the hangar faces the runway and apron area and is surfaced by asphalt pavement.

## 4.1 MATERIALS PRESENT

Within the hangar and below the existing 19.5- to 22-inch-thick concrete floor slab, the stratigraphy generally consists of 2 feet of clayey sand with gravel aggregate base overlying approximately 3 to 4 feet of stiff to very stiff lean to fat clay fine alluvial soils overlying approximately 25 feet of dense to hard silty sandy gravel to clayey gravel coarse alluvial soils. Weathered shale bedrock was found to underly the coarse alluvial soils at a depth of approximately 32 to 33 feet below the slab.

### 4.1.1 Material Descriptions

The near surface clayey sand with gravel encountered below the floor slab was found to be brown, moist, non-plastic and dense in consistency. These gravels were generally alluvial gravels, but some quantities of crushed limestone basecourse were noted in some of the boreholes. It is difficult to discern if these materials are imported and placed subbase materials, or if they are part of the natural alluvial deposits. However, the gravels are interpreted to be aggregate subbase materials based on the uniformity of depth below the slab.

The underlying clay soils were found to be yellowish to olive brown, moist, medium to highly plastic and stiff in consistency.

The underlying silty sandy gravel soils were found to be brown, dry to moist, non-plastic, and very dense to hard in consistency.

The shale bedrock was found to be very dark gray, moist, high plasticity, and hard in consistency.

The geologic logs indicate the specific soil characteristics observed throughout the profiles in each of the boreholes advanced at the site.

## 4.2 GROUNDWATER TABLE

A shallow groundwater table was encountered in Borehole 1 at a depth of 26.5 feet below existing grades, corresponding to an elevation of 3190.5 feet. However, groundwater presence and levels should be anticipated to vary in response to seasonal changes in precipitation, bedrock fracture patterns, high precipitation events, and snow melt, and may not be accurately delineated within the normal scope of a geotechnical evaluation.

## 4.3 GEOLOGIC CONDITIONS

The specific geologic conditions of the site can be described as stratified fine- and coarse-grained alluvial deposits overlying formational shale bedrock. The near surface clays encountered at the site are alluvial or stream laid deposits. The underlying well-graded gravels are associated with terrace deposits which underlie a majority of EAFB. These terrace deposits exist as lenses and thus vary in thickness and tend to pinch out locally. Localized deposits of cobbles and boulders also characterize these terrace deposits. The underlying bedrock is interpreted to be the Pierre Formation, a dark gray to black shale containing concretions and bentonite beds. (Redden and DeWitt, 2009)

Available geologic mapping of the area does not indicate faulting or significant geologic structures which may impact siting, design, or performance of the proposed project. (Redden and DeWitt, 2009)

# 5. CONCLUSIONS AND RECOMMENDATIONS

From our subsurface exploration and engineering analysis, we have arrived at the following conclusions and have the following recommendations regarding foundation design for the proposed construction. The conclusions and recommendations presented in this report do not reflect variations in subsurface conditions that are likely to exist in unexplored areas. Should such variations be revealed during construction, it may be necessary to re-evaluate our recommendations based upon on-site observation of the variations. Also, we should be retained to review the foundation plans, as well as applicable portions of the specifications when they become available.

## 5.1 FOUNDATION SELECTION

We understand 4-foot square by 3-foot-thick pile caps and micropiles will be utilized to support the framing and walls. The subsurface conditions encountered at the boreholes are generally suitable for the construction of pile caps and micropile foundations.

The design and construction parameters and criteria for pile caps and micropile foundations are presented in Section 5.1.1., Section 5.1.2., and below. Micropile foundations are in accordance with FHWA NHI-05-039.

1. A passive pressure resistance of 390 psf can be utilized for pile caps

2. Sliding friction at the base of the pile cap can be taken as 0.24 when founded on native clay soils.

### 5.1.1 Micropile Foundation Design Parameters

**Table 1 - Micropile Foundation Design Parameters**

| *Soil Layer/ Description* | *Depth Interval*[*]*, (feet)* | *L-Pile Soil Type* | *Effective Unit Weight, γ (pcf)* | *Undrained Shear Strength, $S_u$ (psf)* | *$\varepsilon_{50}$, (in/in)* | *Internal Angle of Friction, (deg)* | *p-y Modulus, k, (pci)* | *Ultimate Grout-to-Ground Bond Strength*[**]*, (psi)* | *Allowable Grout-to-Ground Bond Strength, (psi) (FS=2.5)* |
|---|---|---|---|---|---|---|---|---|---|
| 1, Clay | 0-8 | Stiff Clay w/o Free Water | 120 | 1000 | .007 | N/A | 500 | 12 | 4.8 |
| 2, Gravels | 8-26 | Sand (Reese) | 125 | N/A | N/A | 45 | 225 | 30 | 12 |
| 3, Gravels | 26-32 | Sand (Reese) | 62 | N/A | N/A | 45 | 90 | 20 | 8 |
| 3, Shale Bedrock | 32+ | Stiff Clay w/o Free Water | 130 | 3000 | .004 | N/A | 2000 | 70 | 28 |

Note: -Significant variations in the stratigraphy throughout the project will be expected both in terms of depth to and composition of soil layers.

-Groundwater was encountered at a depth of 26.5 feet below existing grades. Although, variations in depth and occurrence will occur.

[*]Depth intervals are from existing grades at the borehole locations and are based on the average depths to strata as encountered in the boreholes.

[**]Ultimate Grout-to-Ground Bond Strengths are for gravity grout only. Additional bond strength may be available if pressure grouting techniques are utilized.

**Uplift capacity can be calculated using 75% of the Ultimate Grout-to-Ground Bond Strength.

### 5.1.2 Micropile Foundation Design and Construction Criteria

1. We suggest the micropile capacity be verified with an instrumented load test. If possible, it should be coordinated such that the reaction piles are also production piles. The data obtained from the analysis of the test pile(s) will determine the actual

micropile capacities and may indicate that modifications to the initial structural designs are necessary.

2. Post-construction total and differential movements between the foundation elements supported by micropiles are not anticipated to exceed ¾ inch and ¼ inch, respectively.

## 5.2 EXISTING HANGAR FLOOR SLAB-ON-GRADE

The existing Pride Hangar floor slab was found to consist of a heavily reinforced concrete slab underlain by approximately 2 feet of dense sandy gravel and clayey sand with gravel aggregate base. The underlying subgrade was found to consist of a stiff to very stiff lean to fat clay soil.

A detailed evaluation of the slab and slab subgrade was performed by FMG in October of 2021 and reported in a report titled, *"Geotechnical Evaluation, EAFB Pride Hangar Supply & Equipment Facility, EAFB, SD", and dated November 4, 2021*. This evaluation utilized Standard Penetration Testing (SPT), Dynamic Cone Penetrometer testing (DCP) and California Bearing Ratio (CBR) testing to assess and develop modulus of subgrade reaction (k, pci) for the slab subgrade materials. The evaluation also provided a detailed review of the slab conditions and reinforcement. An addendum to that report, titled *"Addendum 1 – Shallow Foundation Design Parameters, Geotechnical Evaluation, EAFB Pride Hangar Supply & Equipment Facility, EAFB, SD", and dated December 29, 2021*, was developed to provide shallow foundation design parameters for the slab subgrade.

Based on the findings of this and the previous FMG evaluations, we recommend the following parameters be used when considering the slab subgrade materials.

**Table 2 – Existing Floor Subgrade Parameters**

| Parameter | Recommended Value |
|---|---|
| Aggregate Base Modulus of Subgrade Reaction, (k, pci) | 400 |
| Clay Subgrade Modulus of Subgrade Reaction, (k, pci) | 125 |
| Effective Modulus of Subgrade Reaction, (k, pci) – *Agg. Base and Clay Subgrade Layered System* | 320 |
| Allowable Bearing Capacity, (psf) | 2,500 |
| Sliding Friction Coefficient | 0.40 |

## 5.3 SOIL CORROSIVITY

To assess the corrosivity of the site soils to buried concrete and steel, laboratory chemical analyses and resistivity testing was performed. The results of the laboratory testing are summarized below and presented in Appendix B.

**Table 3 - Soil Corrosivity Testing Summary**

| Parameter | Observed Value |
|---|---|
| pH | 7.82 |
| Soluble Sulfates | 169 ppm |
| Chloride | 23.3 ppm |
| Electrical Resistivity | 1600 ohm-cm |
| Redox Potential: Soil 1 | 98 mV |
| Redox Potential: Soil 2 | 75 mV |
| Redox Potential: Soil 3 | 90 mV |
| Sulfides | 60.4 ppm |

Based on the results of laboratory reactivity testing of representative samples, concrete in contact with the on-site soils will have a moderate exposure (150 ppm to 1500 ppm) to sulfate-containing soils (ACI 318, Table 8.3.1). To provide protection against sulfate related corrosion and in accordance with the referenced ACI document, we recommend a Type I/II cement, a maximum water-cement ratio of 0.50 (by weight, normal weight concrete), and a minimum compressive strength (*f'c*) of 4,000 psi be specified for all concrete exposed to the site soils.

While the sulfates, chlorides and pH levels do not indicate a highly corrosive environment to buried steel (FHWA-NHI-00-043), the average soil resistivity values do indicate high corrosivity potential. The FHWA Report No. FHWA-NHI-00-043 provides criteria for accessing ground corrosion potential, which includes consideration of Sulfates, Resistivity, pH and Chlorides. If the recommended parameters are exceeded for any one of the criteria, FHWA recommends the ground be considered to have a strong or aggressive corrosion potential. Table 4 below provides the criteria and limits discussed herein.

**Table 4 – Criteria for Assessing Ground Corrosion Potential**

| Test | Units | Strong Corrosion Potential/Aggressive |
|---|---|---|
| pH | - | <5, >10 |
| Resistivity | ohm-cm | <3,000 |
| Sulfates | ppm | >200 |
| Chlorides | ppm | >100 |

*FHWA-NHI-00-043

# 6. PROJECT OBSERVATION AND CONSTRUCTION QUALITY ASSURANCE

As the provider of the geotechnical recommendations contained herein, FMG should be retained to provide any necessary pre-construction geotechnical reviews, interpretations, and supplemental information.

If any changes in the nature, design or location of the project are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and conclusions of this report modified or verified in writing.

Frequently, soil conditions vary slightly from those encountered in the borings that were drilled. Therefore, FMG should be retained to review the portions of the plans that pertain to earthwork and foundations.

Our recommendations are based on the necessary assumption that the material and structural element placement will occur as specified and that a detailed construction quality assurance program will be provided that clearly documents the proper placement of materials and structural elements at this site through adequate methods and frequency of testing. In the absence of such quality assurance and documentation, FMG cannot assume responsibility or liability for the performance of any foundation systems, embankments, or structural elements of this project. Should another agent perform the construction quality assurance, said agent will necessarily assume the role and responsibilities of construction-phase geotechnical engineer of record.

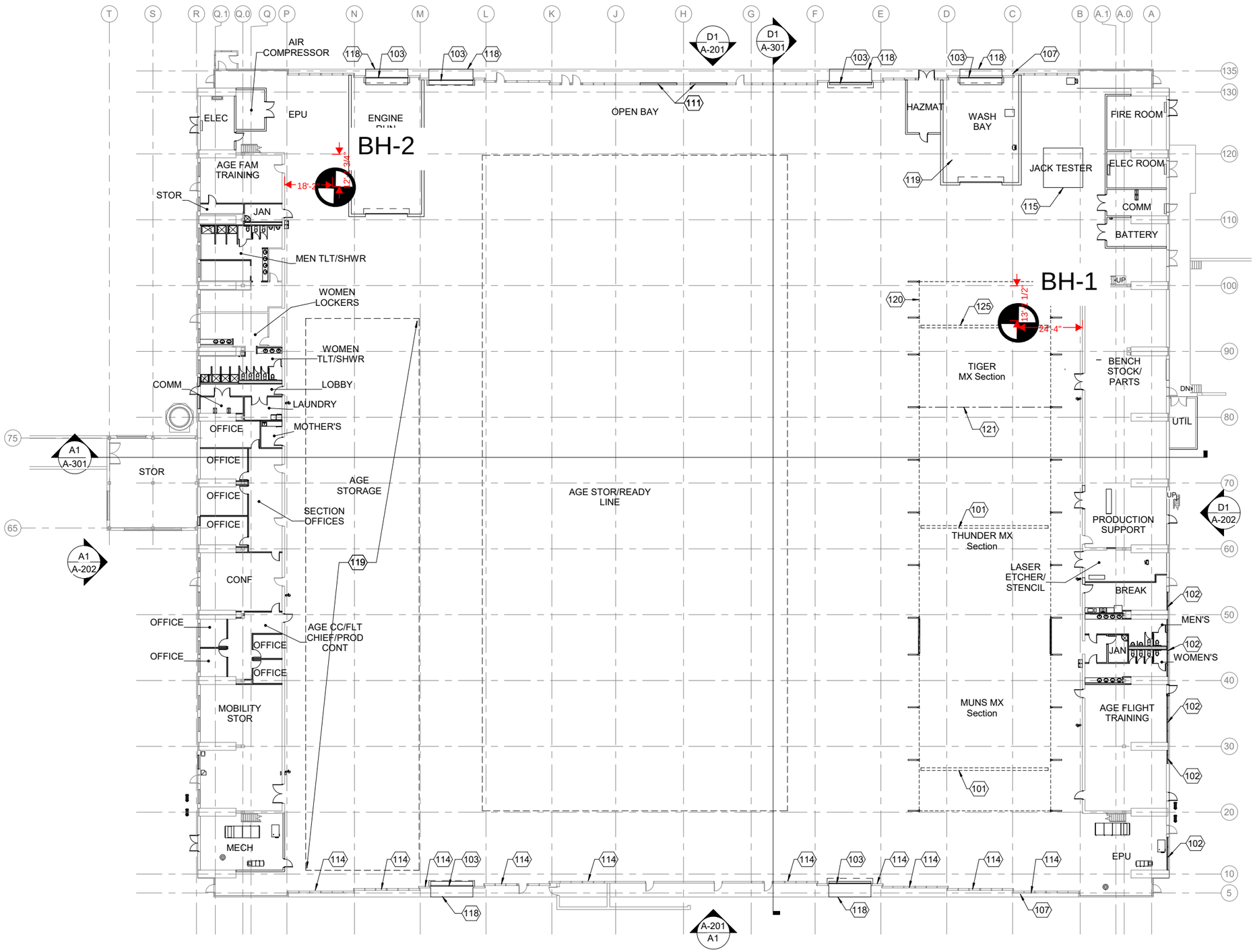
We are available to observe construction operations, particularly the concrete placement operations, the compaction of the fill materials, and other such field observations as may be necessary. Under no circumstances is it our intent to directly control the physical activities of the contractor or the contractor's workmen. Any field testing or observations performed by FMG would be a part of engineering opinions rendered to the contractor and should not be misconstrued as supervision of the contractor's work or workmen.

# 7. CONCLUDING STATEMENT

If any changes in the nature, design or location of the project features are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and conclusions of this report modified or verified in writing.

The findings and recommendations in this report were prepared following accepted soil mechanics procedures and practices. We make no other warranty, either implied or expressed. The conclusions and recommendations of this report are based upon the results of the field exploration boring, field tests, laboratory tests, and analysis. We have extrapolated the data obtained from the test borehole locations to the surrounding soils. Anomalies can exist around the borings. The data presented on the boring logs represent the conditions as encountered in that test hole on the date drilled and logged. If, during planning and construction, conditions are different from those indicated, please notify us so that we can modify the conclusions and recommendations.

c: Z:\221204.00 Jacobs-B21 WLT Facility Geotech\Geotech\221204.00 Jacobs - B21 WLT Facility -- FMG Geotech.docx




Legend

No Scale

BH#1 Borehole Location

FMG ENGINEERING
3700 Sturgis Road
Rapid City, SD 57702
605.342.4105 • fmgengineering.com

File Number: 221204

Location: ??? ???

Surveyed By: N/A
Date: N/A

Drawn By: N/A
Checked By: N/A

EAFB Weapons Loading Training Facility

Ellsworth Air Force Base, SD

September 2022

Revision / Date

Sheet Name: Borehole Location Plan

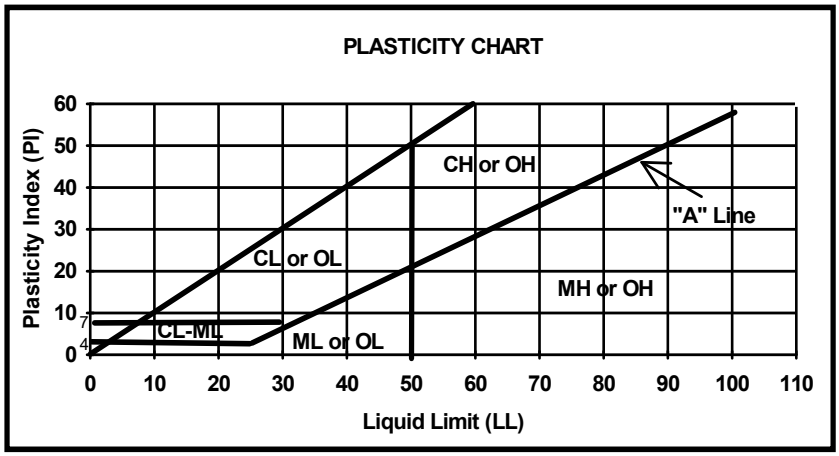
Figure Number: 1

# CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487-90 and D 2488-90 (Unified Soil Classification System)

| Criteria for Assigning Group Symbols and Group Names[A] | | | | Soil Classification Group Symbol | Name |
|---|---|---|---|---|---|
| **COARSE-GRAINED SOILS** More than 50% retained on the No. 200 sieve | **Gravels** More than 50% of coarse fraction retained on No. 4 sieve | Clean Gravels Less than 5% fines[C] | Cu ≥ 4 and 1 ≤ Cc ≤ 3[E] | GW | Well-Graded Gravel[F] |
| | | | Cu < 4 and/or 1 > Cc > 3[E] | GP | PoorlyGradedGravel[F] |
| | | Gravels with Fines More than 12% fines[C] | Fines classify as ML or MH | GM | Silty Gravel[F,G,H] |
| | | | Fines classify as CL or CH | GC | Clayey Gravel[F,G,H] |
| | **Sands** 50% or more of coarse fraction passes No. 4 sieve | Clean Sands Less than 5% fines[D] | Cu ≥ 6 and 1 ≤ Cc ≤ 3[E] | SW | Well-Graded Sand[I] |
| | | | Cu < 6 and/or 1 > Cc > 3[E] | SP | Poorly Graded Sand[I] |
| | | Sands with Fines More than 12% fines[D] | Fines classify as ML or MH | SM | Silty Sand[G,H,J] |
| | | | Fines classify as CL or CH | SC | Clayey Sand[G,H,I] |
| **FINE-GRAINED SOILS** 50% or more passes the No. 200 sieve | **Silts and Clays** Liquid limit less than 50 | inorganic soils | PI>7and on or above "A" line[J] | CL | Lean Clay[K,L,M] |
| | | | PI<4 or plots below "A" line[J] | ML | Silt[K,L,M] |
| | | organic soils | Liquid limit-oven dried / Liquid limit-not dried < .75 | OL | Organic Clay[K,L,M,N] / Organic Silt[K,L,M,O] |
| | **Silts and Clays** Liquid limit 50 or more | inorganic soils | PI plots on or above "A" line | CH | Fat Clay[K,L,M] |
| | | | PI plots below "A" line | MH | Elastic Silt[K,L,M] |
| | | organic soils | Liquid limit-oven dried / Liquid limit-not dried < .75 | OH | Organic Clay[K,L,M,P] / Organic Silt[K,L,M,Q] |
| **HIGHLY ORGANIC SOILS** | | Primarily organic matter, dark in color, and organic odor | | PT | Peat |

*A.* Based on the material passing the 3-in. (75-mm) sieve.
*B.* If field sample contained cobbles or boulders, or both, add "with cobbles and boulders, or both" to group name.
*C.* Gravels with 5% to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay
*D.* Sands with 5% to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay
*E.* $Cu = D_{60}/D_{10}$ $Cc=(D_{30})^2/D_{10}xD_{60}$
*F.* If soil contains ≥ 15% sand, add "with sand" to group name.
*G.* If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM
*H.* If fines are organic, add "with organic fines" to group name.
*I.* If soil contains ≥ 15% gravel, add "with gravel" to group name.
*J.* If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.
*K.* If soil contains 15% to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
*L.* If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
*M.* If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravely" to group name.
*N.* PI ≥ 4 and plots on or above "A" line.
*O.* PI < 4 or plots below "A" line.
*P.* PI plots on or above "A" line.
*Q.* PI plots below "A" line.




Equation of "A" - line: Horizontal at PI = 4 to LL = 25.5, then PI = 0.73(LL-20) (Chart is for general graphic presentation purposes only)

**- Figure 3-**

# Appendix A

## Borehole Logs

**PROJECT:** Weapons Loader Training Facility

**LOCATION:** EAFB, SD

**PROJECT #:** 221204

**DATE STARTED:** 9/13/22 **COMP.:** 9/13/22

**CONTRACTOR:** FMG Engineering

**DRILL METHOD:** Solid Stem Auger/Moile B57

# GEOLOGIC LOG OF BOREHOLE 1

FMG ENGINEERING
605-342-4105
3700 Sturgis Road
Rapid City, SD 57702
fmgengineering.com

**BORING LOCATION:** SeeFigure 1
East Corner of Hangar

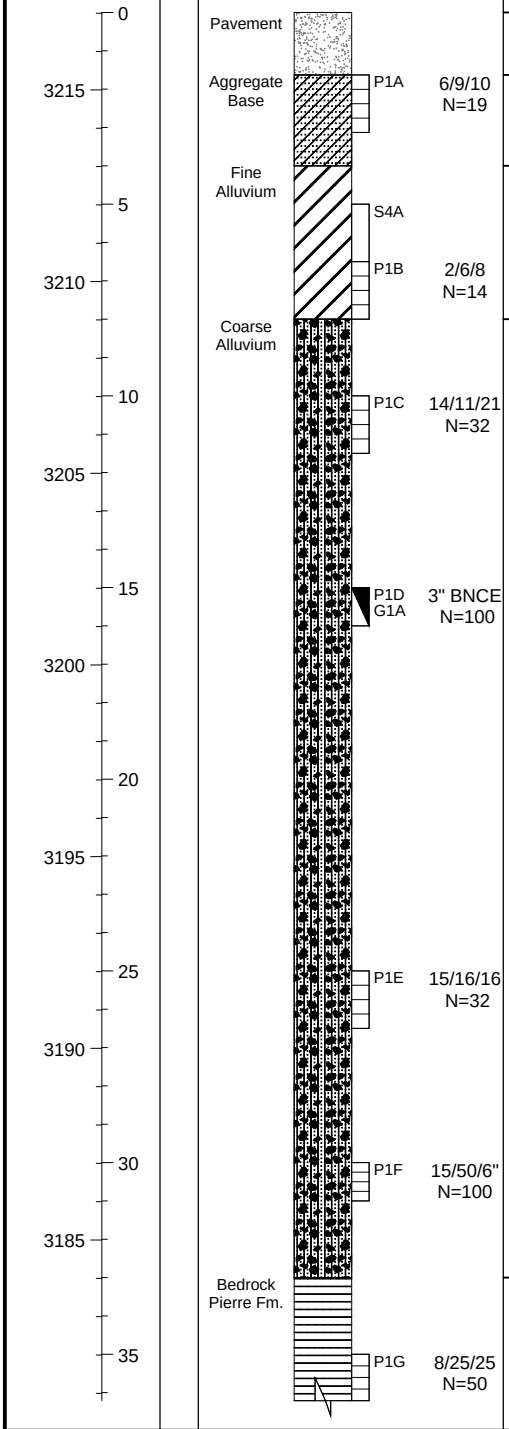
**GROUND ELEVATION:** 3217.02

**DATUM:** Site Topo

**BORING DIAMETER:** 5"

**COLLAPSE DEPTH:** N/A

**FILL DEPTH:** N/A




| ELEVATION / DEPTH | WATER | GEOLOGY GRAPHIC | Sample Info Type,#/Blows | USCS | DESCRIPTION | NM % | DD (pcf) | LL (%) | PI (%) | Qu (psf) | phi (deg) | Swell (%) (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Conc | Concrete Pavement: 19.5 inches in thickness | | | | | | | |
| | | | | SC | Clayey Sand with Gravel: Brown, moist, low plasticity, dense. | | | | | | | |
| | | | | CH | Fat Clay: Yellowish brown, moist, high plasticity, stiff. | | | | | | | |
| | | | | SM-GM | Silty Sandy Gravel: Brown, dry, non plastic, very dense to hard, well graded, subrounded to subangular. | | | | | | | |
| | | | | GM | | 3.5 | | NV | NP | | 42 | |
| | | | | GM | | 2.8 | | NV | NP | | | |
| | | | | SHALE | Shale: Very dark gray, moist, high plasticity, hard. | | | | | | | |

SEE ATTACHED KEY FOR ABBREVIATIONS, NOTES & DESCRIPTIONS

**PROJECT:** Weapons Loader Training Facility

**LOCATION:** EAFB, SD

**PROJECT #:** 221204

**DATE STARTED:** 9/13/22 **COMP.:** 9/13/22

**CONTRACTOR:** FMG Engineering

**DRILL METHOD:** Solid Stem Auger/Moile B57

# GEOLOGIC LOG OF BOREHOLE 1

FMG ENGINEERING
605-342-4105
3700 Sturgis Road
Rapid City, SD 57702
fmgengineering.com

**BORING LOCATION:** SeeFigure 1
East Corner of Hangar

**GROUND ELEVATION:** 3217.02

**DATUM:** Site Topo

**BORING DIAMETER:** 5"

**COLLAPSE DEPTH:** N/A

**FILL DEPTH:** N/A

| ELEVATION / DEPTH | WATER | GEOLOGY GRAPHIC | Sample Info Type,#/Blows | USCS | DESCRIPTION | NM % | DD (pcf) | LL (%) | PI (%) | Qu (psf) | phi (deg) | Swell (%) (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3180 | | | | | | | | | | | | |
| 40 | | | P1H 50/6" N=100 | | -End of Borehole at 40.5Ft. Groundwater encountered at 25Ft during drilling. | | | | | | | |
| 3175 | | | | | | | | | | | | |
| 45 | | | | | | | | | | | | |
| 3170 | | | | | | | | | | | | |
| 50 | | | | | | | | | | | | |
| 3165 | | | | | | | | | | | | |
| 55 | | | | | | | | | | | | |
| 3160 | | | | | | | | | | | | |
| 60 | | | | | | | | | | | | |
| 3155 | | | | | | | | | | | | |
| 65 | | | | | | | | | | | | |
| 3150 | | | | | | | | | | | | |
| 70 | | | | | | | | | | | | |
| 3145 | | | | | | | | | | | | |

SEE ATTACHED KEY FOR ABBREVIATIONS, NOTES & DESCRIPTIONS

**PROJECT:** Weapons Loader Training Facility

**LOCATION:** EAFB, SD

**PROJECT #:** 221204

**DATE STARTED:** 9/13/22 **COMP.:** 9/13/22

**CONTRACTOR:** FMG Engineering

**DRILL METHOD:** Solid Stem Auger/Moile B57

# GEOLOGIC LOG OF BOREHOLE 2

FMG ENGINEERING
605-342-4105
3700 Sturgis Road
Rapid City, SD 57702
fmgengineering.com

**BORING LOCATION:** SeeFigure 1 North Corner

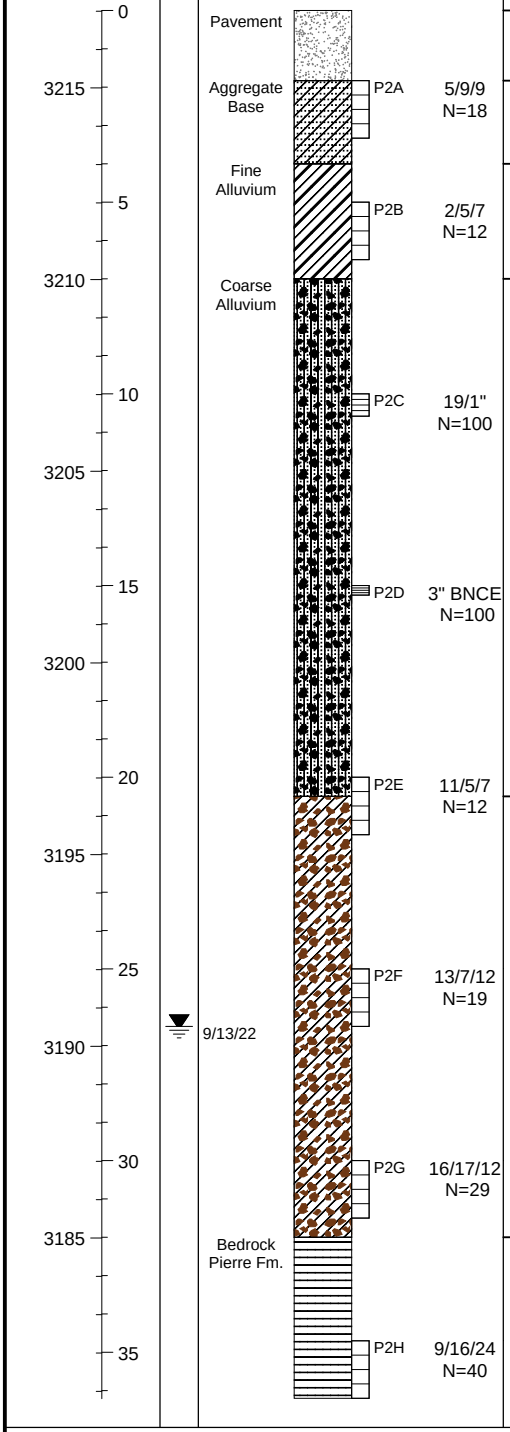
**GROUND ELEVATION:** 3217.02

**DATUM:** Site Topo

**BORING DIAMETER:** 5"

**COLLAPSE DEPTH:** N/A

**FILL DEPTH:** N/A




| ELEVATION / DEPTH | WATER | GEOLOGY GRAPHIC | Sample Info Type,#/Blows | USCS | DESCRIPTION | NM % | DD (pcf) | LL (%) | PI (%) | Qu (psf) | phi (deg) | Swell (%) (ksf) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Conc | Concrete Pavement: 22 inches in thickness | | | | | | | |
| | | | P2A 5/9/9 N=18 | SC | Clayey Sand with Gravel: yellowish brown, moist, non-plastic, dense. | | | | | | | |
| | | | P2B 2/5/7 N=12 | CL-CH | Lean to Fat Clay: Olive brown, moist, medium plasticity, stiff. | | | | | | | |
| | | | P2C 19/1" N=100 | SM-GM | Silty Sandy Gravel: Brown, dry, non-plastic, hard, well graded, subrounded to subangular | | | | | | | |
| | | | P2D 3" BNCE N=100 | | | | | | | | | |
| | | | P2E 11/5/7 N=12 | GC | Clayey Gravel: Olive brown, moist, low plasticity, dense, well graded, subrounded to subangular. | | | | | | | |
| | ▽ | | P2F 13/7/12 N=19 | GC | -Becomes saturated | 16.2 | | 70 | 36 | | 54 | |
| | | | P2G 16/17/12 N=29 | GC | | 12.5 | | 42 | 20 | | | |
| | | | | SHALE | Shale: Very dark gray, moist, high plasticity, hard. | | | | | | | |
| | | | P2H 9/16/24 N=40 | MH | -End of Borehole at 36.5 feet. Groundwater encountered at 26.5' while drilling. | 27.4 | | 79 | 35 | | | |

SEE ATTACHED KEY FOR ABBREVIATIONS, NOTES & DESCRIPTIONS

# KEY TO SYMBOLS

| Symbol | Description |
|---|---|
| Strata Symbols | |
| | Concrete |
| | Clayey sand |
| | High plasticity clay |
| | Silty sandy gravel |
| | Shale |
| | Low-high plasticity clays |
| | Clayey gravel |
| Misc. Symbols | |
| | Boring continues |

Notes:

1. The exploratory borings were drilled on the dates presented on the geologic logs. Please refer to the attached Soils Classification System Chart (Figure 2) for more detailed explanations on the soils and their properties.

2. The geologic logs of the boreholes and related information depict only the conditions and materials encountered at the specific boring location and at the particular time designated on the logs. Soil conditions at other locations will vary from those indeicated at each specific boring or sampling location. The given depths of material changes and the sample depths are approximate. Variations will occur.

3. These Logs are subject to the limitations, conclusions and recommendations provided in this report.

4. The numbers adjacent to the SPT sample locations are the blow/interval and represent the number of blows required to drive the 1" I.D. split spoon sampler the given distance into the soil with a 140# automatic hammer that drops 30". The SPT test is performed to a lenght of 18". The N Value for each given SPT is the number of blows required to drive the 1" I.D. sampler into the last 12".

5. Cobbles, boulders and other large objects generally cannot be recovered from borings, and they may be present in the subsurface even if not noted on the Logs.

6. The topsoil thicknesses indicated on the Logs are for general informational purposes only, and are based on general transistions and very limited sampling points, and should not be used to calculate topsoil stripping depths or volumes. Significant variations in topsoil thickness will occur throughout the project.

7. The ground elevations noted on the logs are approximate, and should only be used for general reference.

The results of some tests conducted on samples recovered are reported on the Logs. Abbreviations used are:
NM = Natural Moisture Content of the Soil (%)
DD = Dry Density of the Soil (pcf)
LL = Atterburg Liquid Limit of the Soil (%)
PI = Atterburg Plasticity Index of the Soil (%)
phi = Internal Angle of Friction (degrees)
Qu = Unconfined Compressive Strength (psf)
Swell % = Percent Swell Against 100psf Surcharge Upon Saturation (%)
Swell Press = Maximum Swell Pressure (ksf)

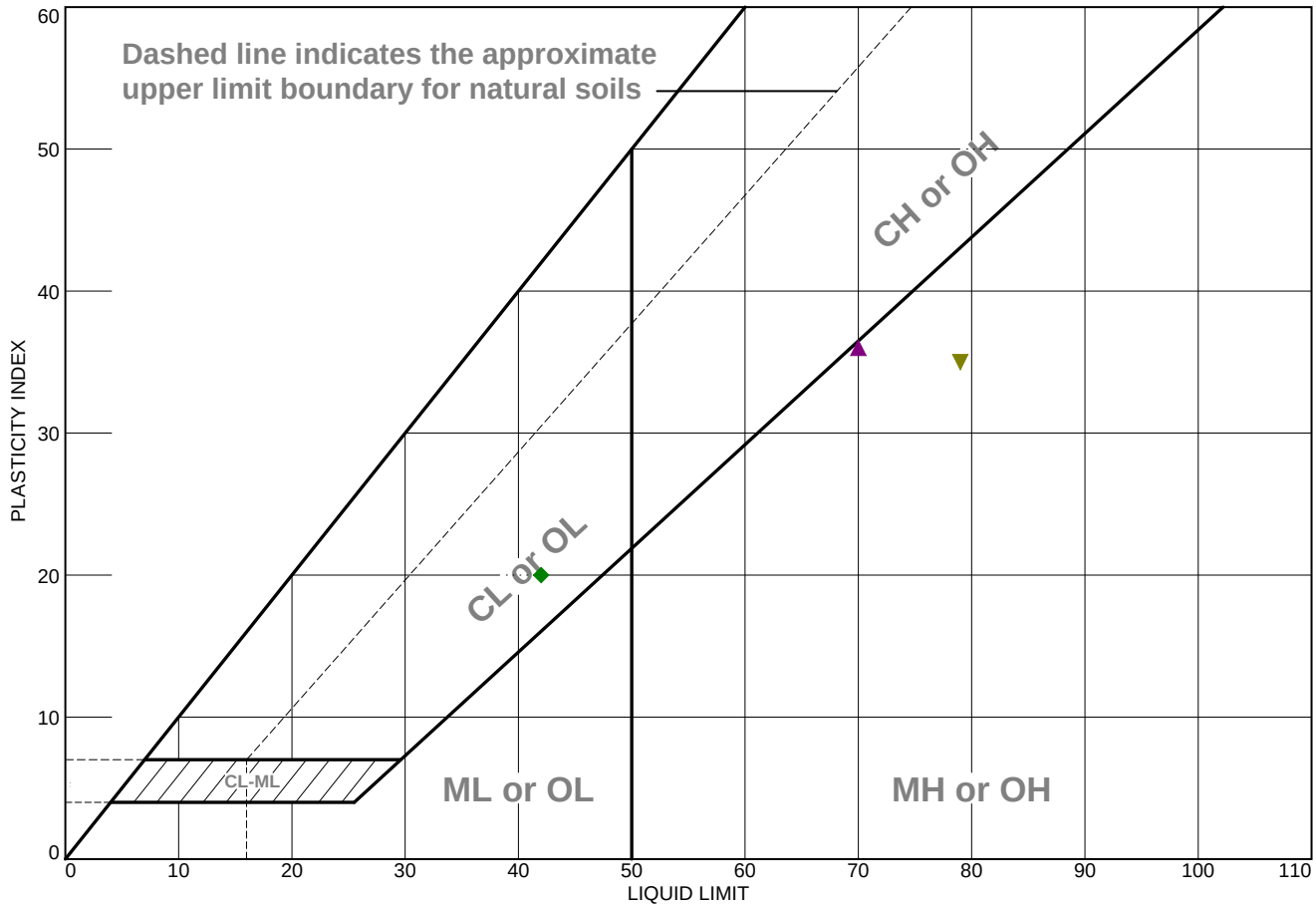
# KEY TO SYMBOLS

| Symbol | Description |
|---|---|
| Misc. Symbols | |
| | Water level during drilling |
| Soil Samplers | |
| | Standard Penetration Test Sample |
| | Undisturbed thin wall Shelby tube |
| | Bulk/Grab sample |

# Appendix B

## Laboratory Testing

# LIQUID AND PLASTIC LIMITS TEST REPORT




| | MATERIAL DESCRIPTION | LL | PL | PI | %<#40 | %<#200 | USCS |
|---|---|---|---|---|---|---|---|
| ● | Silty Sandy Gravel: Brown, dry, non plastic, very dense to hard, well graded, subrounded to subangular. | NV | NP | NP | 20 | 15 | GM |
| ■ | Silty Sandy Gravel: Brown, dry, non plastic, very dense to hard, well graded, subrounded to subangular. | NV | NP | NP | 19 | 15 | GM |
| ▲ | Clayey Gravel: Olive brown, moist, low plasticity, dense, well graded, subrounded to subangular. | 70 | 34 | 36 | 51 | 40 | GC |
| ◆ | Clayey Gravel: Olive brown, moist, low plasticity, dense, well graded, subrounded to subangular. | 42 | 22 | 20 | 19 | 14 | GC |
| ▼ | Shale: Very dark gray, moist, high plasticity, hard. | 79 | 44 | 35 | 99 | 98 | MH |

**Project No.** 221204 **Client:** Jacobs

**Project:** Weapons Loader Training Facility

**Remarks:**

● **Source of Sample:** 1 **Depth:** 10 **Sample Number:** P1C

■ **Source of Sample:** 1 **Depth:** 15 **Sample Number:** G1A

▲ **Source of Sample:** 2 **Depth:** 25 **Sample Number:** P2F

◆ **Source of Sample:** 2 **Depth:** 30 **Sample Number:** P2G

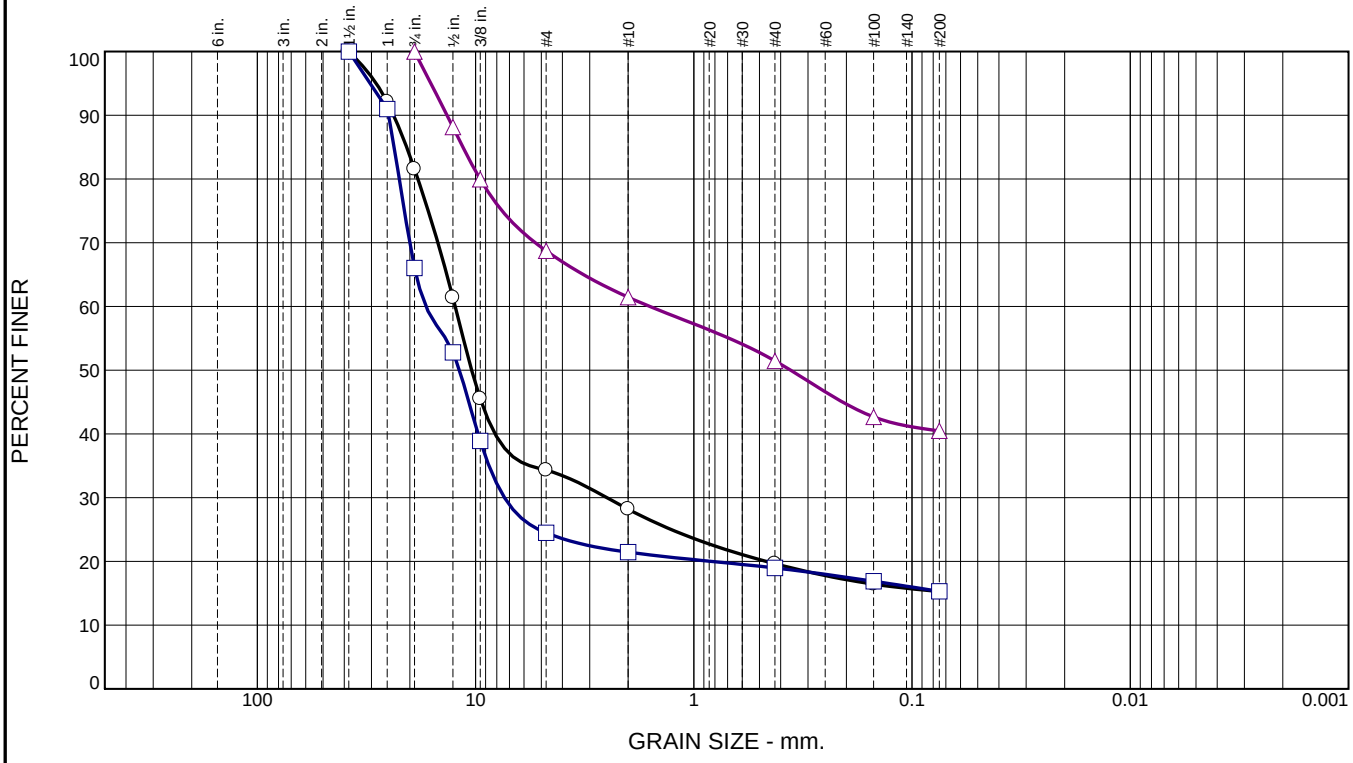
▼ **Source of Sample:** 2 **Depth:** 34.7 **Sample Number:** P2H

**FMG, Inc.**

**Figure**

**Tested By:** RC **Checked By:** RC

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | LL | PL | PI |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0 | 66 | 19 | 15 | | GM | NV | NP | NP |
| □ | 0 | 76 | 9 | 15 | | GM | NV | NP | NP |
| △ | 0 | 31 | 29 | 40 | | GC | 70 | 34 | 36 |

| SIEVE inches size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| 1 1/2 | 100 | 100 | |
| 1 | 92 | 91 | |
| 3/4 | 82 | 66 | 100 |
| 1/2 | 61 | 53 | 88 |
| 3/8 | 46 | 39 | 80 |
| GRAIN SIZE | | | |
| $D_{60}$ | 12.4007 | 16.8824 | 1.5909 |
| $D_{30}$ | 2.5047 | 7.3703 | |
| $D_{10}$ | | | |
| COEFFICIENTS | | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | □ | △ |
|---|---|---|---|
| #4 | 34 | 24 | 69 |
| #10 | 28 | 21 | 61 |
| #40 | 20 | 19 | 51 |
| #100 | 16 | 17 | 43 |
| #200 | 15 | 15 | 40 |

Material Description

○ Silty Sandy Gravel: Brown, dry, non plastic, very dense to hard, well graded, subrounded to subangular.

□ Silty Sandy Gravel: Brown, dry, non plastic, very dense to hard, well graded, subrounded to subangular.

△ Clayey Gravel: Olive brown, moist, low plasticity, dense, well graded, subrounded to subangular.

REMARKS:

○ Source of Sample: 1 Depth: 10 Sample Number: P1C

□ Source of Sample: 1 Depth: 15 Sample Number: G1A

△ Source of Sample: 2 Depth: 25 Sample Number: P2F

FMG, Inc.

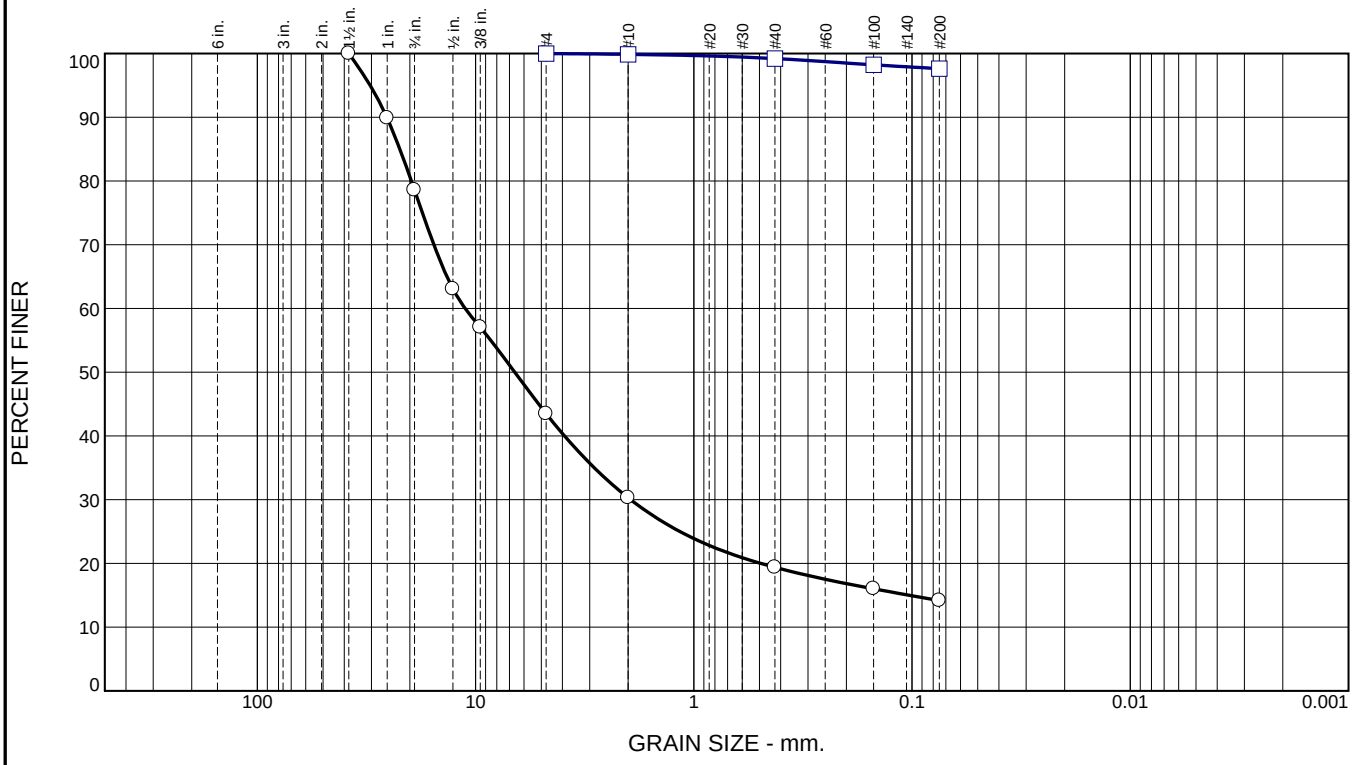
Client: Jacobs

Project: Weapons Loader Training Facility

Project No.: 221204 Figure

**Tested By:** RC **Checked By:** RC

# Particle Size Distribution Report




| | +3" | % GRAVEL | % SAND | % SILT | % CLAY | USCS | LL | PL | PI |
|---|---|---|---|---|---|---|---|---|---|
| ○ | 0 | 57 | 29 | 14 | | GC | 42 | 22 | 20 |
| □ | 0 | 0 | 2 | 98 | | MH | 79 | 44 | 35 |
| | | | | | | | | | |

| SIEVE inches size | PERCENT FINER ○ | □ | |
|---|---|---|---|
| 1 1/2 | 100 | | |
| 1 | 90 | | |
| 3/4 | 79 | | |
| 1/2 | 63 | | |
| 3/8 | 57 | | |
| | GRAIN SIZE | | |
| $D_{60}$ | 11.1703 | | |
| $D_{30}$ | 1.9492 | | |
| $D_{10}$ | | | |
| | COEFFICIENTS | | |
| $C_c$ | | | |
| $C_u$ | | | |

| SIEVE number size | PERCENT FINER ○ | □ |
|---|---|---|
| #4 | 43 | 100 |
| #10 | 30 | 100 |
| #40 | 19 | 99 |
| #100 | 16 | 98 |
| #200 | 14 | 98 |

Material Description

○ Clayey Gravel: Olive brown, moist, low plasticity, dense, well graded, subrounded to subangular.

□ Shale: Very dark gray, moist, high plasticity, hard.

REMARKS:

○

□

○ Source of Sample: 2 Depth: 30 Sample Number: P2G

□ Source of Sample: 2 Depth: 34.7 Sample Number: P2H

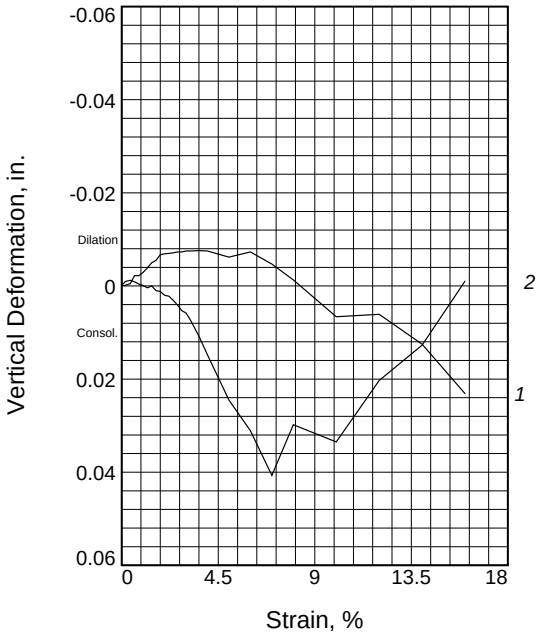
**FMG, Inc.**

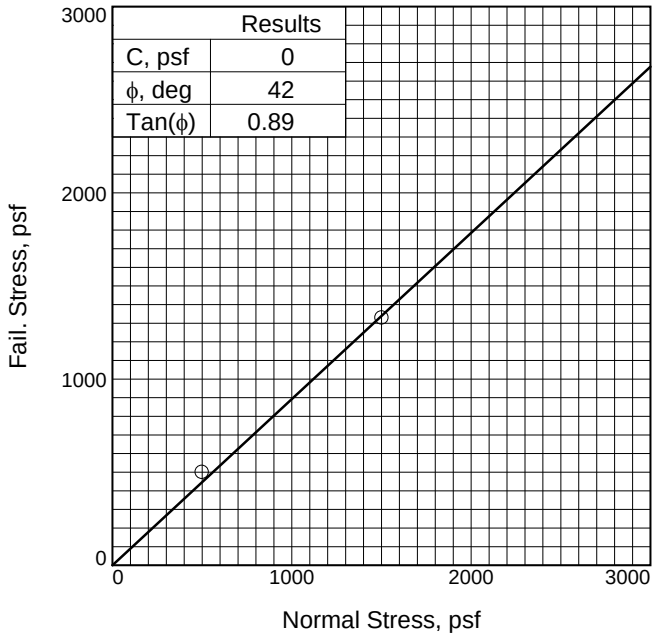
Client: Jacobs

Project: Weapons Loader Training Facility

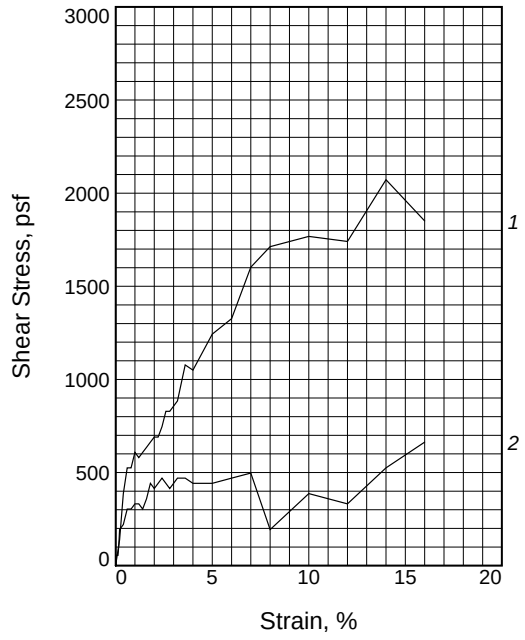
Project No.: 221204 Figure

**Tested By:** RC **Checked By:** RC




| Results | |
|---|---|
| C, psf | 0 |
| ϕ, deg | 42 |
| Tan(ϕ) | 0.89 |




| Sample No. | | 1 | 2 |
|---|---|---|---|
| Initial | Water Content, % | 3.5 | 3.5 |
| | Dry Density, pcf | 73.5 | 73.6 |
| | Saturation, % | 7.3 | 7.3 |
| | Void Ratio | 1.2496 | 1.2491 |
| | Diameter, in. | 2.50 | 2.50 |
| | Height, in. | 1.00 | 1.00 |
| At Test | Water Content, % | 11.0 | 12.7 |
| | Dry Density, pcf | 75.4 | 72.0 |
| | Saturation, % | 24.3 | 25.9 |
| | Void Ratio | 1.1954 | 1.2966 |
| | Diameter, in. | 2.50 | 2.50 |
| | Height, in. | 0.98 | 1.02 |
| Normal Stress, psf | | 1504 | 503 |
| Fail. Stress, psf | | 1326 | 497 |
| Strain, % | | 6.0 | 7.0 |
| Ult. Stress, psf | | | |
| Strain, % | | | |
| Strain rate, in./min. | | 0.010 | 0.010 |

**Sample Type:** SPT
**Description:** Silty Sandy Gravel: Brown, dry, non plastic, very dense to hard, well graded, subrounded
**LL=** NV **PI=** NP
**Assumed Specific Gravity=** 2.65
**Remarks:** Remolded at 95 dry density and 3% moisture. Approximately 50% >#4 sieve, 50% <#4 sieve.

**Figure** _____

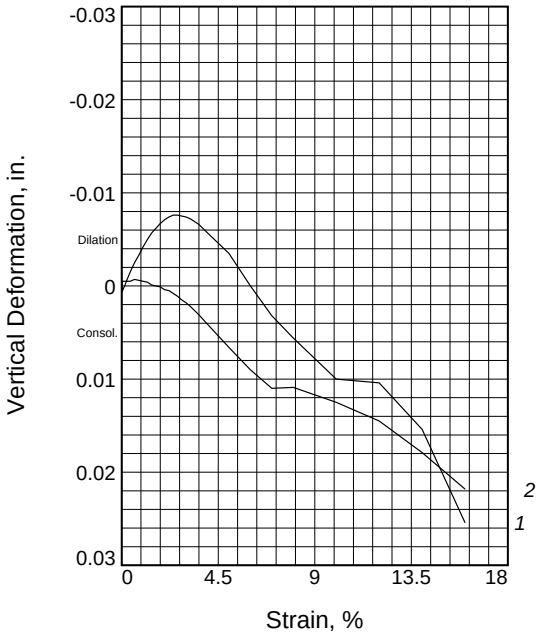
**Client:** Jacobs

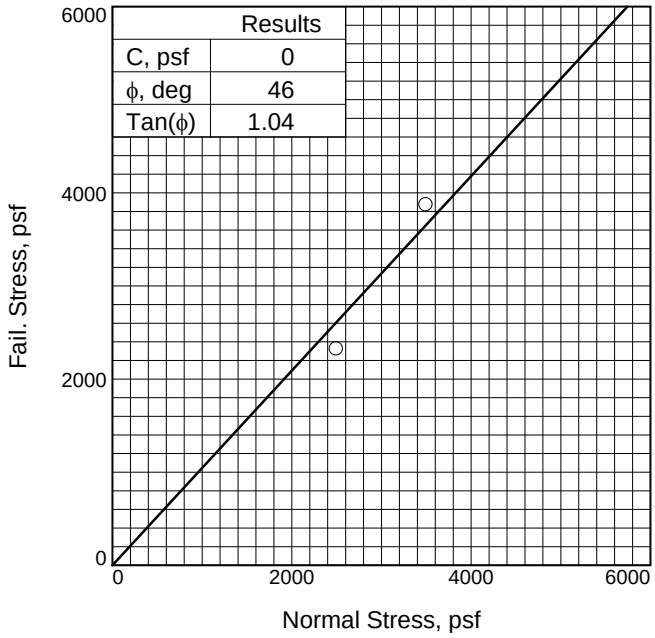
**Project:** Weapons Loader Training Facility

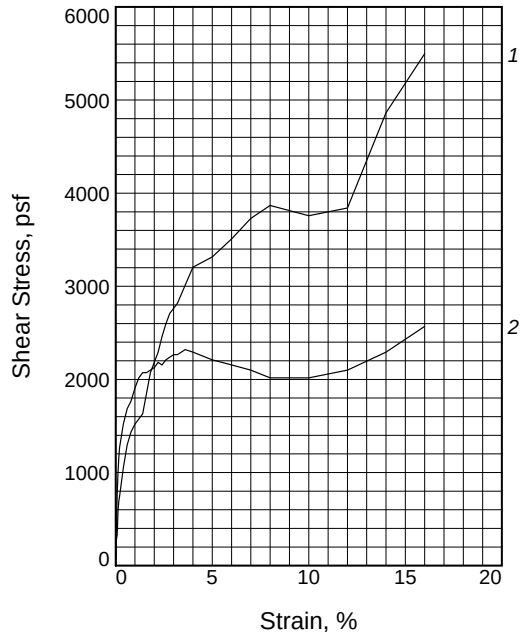
**Source of Sample:** 1 **Depth:** 10
**Sample Number:** P1C
**Proj. No.:** 221204 **Date Sampled:** 9/13/22

FMG, Inc.

**Tested By:** RC **Checked By:** RC




| Sample No. | | 1 | 2 |
|---|---|---|---|
| Initial | Water Content, % | 16.2 | 16.2 |
| | Dry Density, pcf | 109.4 | 108.9 |
| | Saturation, % | 83.7 | 82.5 |
| | Void Ratio | 0.5116 | 0.5186 |
| | Diameter, in. | 2.50 | 2.50 |
| | Height, in. | 1.00 | 1.00 |
| At Test | Water Content, % | 19.9 | 23.9 |
| | Dry Density, pcf | 100.9 | 99.0 |
| | Saturation, % | 82.5 | 94.6 |
| | Void Ratio | 0.6391 | 0.6705 |
| | Diameter, in. | 2.50 | 2.50 |
| | Height, in. | 1.08 | 1.10 |
| Normal Stress, psf | | 3501 | 2502 |
| Fail. Stress, psf | | 3868 | 2321 |
| Strain, % | | 8.0 | 3.6 |
| Ult. Stress, psf | | | |
| Strain, % | | | |
| Strain rate, in./min. | | 0.010 | 0.010 |

**Sample Type:** SPT remolded
**Description:** Clayey Gravel: Olive brown, moist, low plasticity, dense, well graded, subrounded to
**LL=** 70 **PL=** 34 **PI=** 36
**Assumed Specific Gravity=** 2.65
**Remarks:**

**Figure** _____

**Client:** Jacobs

**Project:** Weapons Loader Training Facility

**Source of Sample:** 2 **Depth:** 25
**Sample Number:** P2F
**Proj. No.:** 221204 **Date Sampled:** 9/13/22

FMG, Inc.

**Tested By:** RC **Checked By:** RC

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Sample Site: G8A
Project Name: EAFB WFT
Project Number: 211018
Sampled: 09/14/22 at 11:00 AM
by Ryan W Cos
Sample Matrix: Soil

ALEX FISHER
FMG
3700 STURGIS RD
RAPID CITY, SD 57702

Lab ID#: 20220914702
Received: 09/14/22 at 11:35 AM
by Dean Aurand
Account: W1023 - FMG

| Parameter | Result | Units | DF | MDL | PQL | Method | Analyst | Date |
|---|---|---|---|---|---|---|---|---|
| **Physical Properties** | | | | | | | | |
| ORP in Soil 1 0f 3 readings | 98.0 | mV | 1 | | | ASTM G200-09 | MEM | 09/26/22 |
| ORP in Soil 2 0f 3 readings | 75.0 | mV | 1 | | | ASTM G200-09 | MEM | 09/26/22 |
| ORP in Soil 3 0f 3 readings | 90.0 | mV | 1 | | | ASTM G200-09 | MEM | 09/26/22 |
| pH | 7.82 | S.U. | 1 | | | EPA SW846 9045C | TMN | 09/14/22 |
| **Non-Metallics** | | | | | | | | |
| Chloride (Cl-) | 23.3 | mg/L | 1 | 0.231 | 0.500 | SM 4500-Cl E | BLL | 09/19/22 |
| Sulfate (SO4) | 169 | mg/L | 5 | 4.64 | 50.0 | SM 4500-SO4 E | BLL | 09/19/22 |
| **Metals - Total** | | | | | | | | |
| Sulfur (S) | 60.4 | mg/L | 10 | | | EPA 200.7 | TNA | 10/03/22 |

Report Approved By:

Report Approved On: 10/4/2022 11:23:51 AM

MIDCONTINENT
TESTING LABORATORIES, INC.

2381 South Plaza Drive P.O. Box 3388 Rapid City, SD 57709
(605) 348-0111 -- www.thechemistrylab.com

Lab Numbers: 20220914702 - 20220914702

# QC Sample Report

| Parameter | Lab# | QC Value | Smp Value | Spike | DF | Result | Limits | Method | |
|---|---|---|---|---|---|---|---|---|---|
| **Spike** | | | | | | | | | |
| Chloride | 0919107 | 53.1 | 43.7 | 5.00 | 2 | 93.1 % | (84.86) - (115.3) | SM 4500-Cl E | |
| Sulfate | 0915106 | 323 | 243 | 19.2 | 5 | 93.4 % | (85.17) - (113.9) | SM 4500-SO4 E | |
| Sulfate | 0914974 | 2060 | 1340 | 19.2 | 40 | 99.97% | (85.17) - (113.9) | SM 4500-SO4 E | |
| Sulfate | 0915840 | 58.3 | 40.8 | 19.2 | 1 | 99.64% | (84.32) - (114.2) | SM 4500-SO4 E | |
| Sulfur - T | 0922957 | 20.7 | 10.1 | 5.00 | 2 | 106.0 % | | EPA 200.7 | |
| **Matrix Spike Duplicate** | | | | | | | | | |
| Chloride | 0919107 | 53.0 | 53.1 | | 2 | -0.189% | (-3.760) - (2.635) | SM 4500-Cl E | |
| Sulfate | 0915106 | 323 | 323 | | 5 | -0.173% | (-4.558) - (4.186) | SM 4500-SO4 E | |
| Sulfate | 0914974 | 2050 | 2060 | | 40 | -0.340% | (-4.558) - (4.186) | SM 4500-SO4 E | |
| Sulfate | 0915840 | 59.0 | 58.3 | | 1 | 1.16% | (-4.475) - (3.846) | SM 4500-SO4 E | |
| Sulfur - T | 0922957 | 21.6 | 20.7 | | 2 | 3.98% | | EPA 200.7 | |
| **Duplicate** | | | | | | | | | |
| ORP reading 1 | 0914702 | 118 | 98.0 | | 1 | 18.5 % | | ASTM G200-09 | X |
| - Recovery was within 20% of expected value. | | | | | | | | | |
| ORP reading 2 | 0914702 | 67.0 | 75.0 | | 1 | -11.3 % | | ASTM G200-09 | |
| ORP reading 3 | 0914702 | 69.0 | 90.0 | | 1 | -26.4 % | | ASTM G200-09 | X |
| - Non-homogenous sample, generally attributed to soil compositions. | | | | | | | | | |
| pH | 0914702 | 7.91 | 7.82 | | 1 | 1.14% | (-3.422) - (4.431) | EPA SW846 9045C | |
| - Recovery was within 10% of expected value | | | | | | | | | |
| pH | 0914702 | 7.91 | 7.82 | | 1 | 1.14% | (-3.422) - (4.431) | EPA SW846 9045C | |
| - Recovery was within 10% of expected value | | | | | | | | | |
| Chloride | 0919107 | 43.7 | 43.5 | | 2 | 0.504% | (-8.636) - (8.856) | SM 4500-Cl E | |
| Sulfate | 0914974 | 1340 | 1310 | | 40 | 2.39% | (-5.183) - (6.112) | SM 4500-SO4 E | |
| Sulfate | 0915106 | 243 | 236 | | 5 | 2.98% | (-5.183) - (6.112) | SM 4500-SO4 E | |
| Sulfate | 0915840 | 40.8 | 39.8 | | 1 | 2.33% | (-5.237) - (6.348) | SM 4500-SO4 E | |
| **Initial Calibration Verification** | | | | | | | | | |
| ORP reading 1 | | 388 | 400 | | 1 | -3.00% | | ASTM G200-09 | |
| ORP reading 2 | | 393 | 400 | | 1 | -1.75% | | ASTM G200-09 | |
| ORP reading 3 | | 393 | 400 | | 1 | -1.75% | | ASTM G200-09 | |
| Chloride | | 24.1 | 25.0 | | 1 | -3.44% | (-10.65) - (10.28) | SM 4500-Cl E | |
| Sulfate | | 50.8 | 50.0 | | 1 | 1.52% | (-4.620) - (7.728) | SM 4500-SO4 E | |
| Sulfate | | 50.2 | 50.0 | | 1 | 0.440% | (-4.516) - (7.732) | SM 4500-SO4 E | |
| Sulfur - T | | 10.9 | 10.0 | | 1 | 9.10% | | EPA 200.7 | |

Lab Numbers: **20220914702 - 20220914702**

| Parameter | Lab# | QC Value | Smp Value | Spike | DF | Result | Limits | Method |
|---|---|---|---|---|---|---|---|---|
| **Continuing Calibration Verification** | | | | | | | | |
| ORP reading 1 | | 374 | | 400 | 1 | -6.50% | | ASTM G200-09 |
| ORP reading 2 | | 377 | | 400 | 1 | -5.75% | | ASTM G200-09 |
| ORP reading 3 | | 380 | | 400 | 1 | -5.00% | | ASTM G200-09 |
| pH | | 4.09 | | 4.09 | 1 | 0.00% | (-2.268) - (2.572) | EPA SW846 9045C |
| pH | | 3.99 | | 4.00 | 1 | -0.250% | (-2.268) - (2.572) | EPA SW846 9045C |
| pH | | 7.06 | | 7.00 | 1 | 0.857% | (-2.268) - (2.572) | EPA SW846 9045C |
| pH | | 7.00 | | 7.00 | 1 | 0.00% | (-2.268) - (2.572) | EPA SW846 9045C |
| pH | | 3.99 | | 4.00 | 1 | -0.250% | (-2.268) - (2.572) | EPA SW846 9045C |
| pH | | 7.09 | | 7.00 | 1 | 1.29% | (-2.268) - (2.572) | EPA SW846 9045C |
| Chloride | | 25.6 | | 25.0 | 1 | 2.28% | (-11.40) - (10.42) | SM 4500-Cl E |
| Chloride | | 25.5 | | 25.0 | 1 | 1.80% | (-11.40) - (10.42) | SM 4500-Cl E |
| Sulfate | | 53.5 | | 50.0 | 1 | 6.96% | (1.900) - (9.246) | SM 4500-SO4 E |
| Sulfate | | 53.1 | | 50.0 | 1 | 6.26% | (1.900) - (9.246) | SM 4500-SO4 E |
| Sulfate | | 53.4 | | 50.0 | 1 | 6.88% | (2.971) - (8.359) | SM 4500-SO4 E |
| Sulfate | | 52.6 | | 50.0 | 1 | 5.12% | (2.971) - (8.359) | SM 4500-SO4 E |
| Sulfur - T | | 7.52 | | 7.50 | 1 | 0.213% | | EPA 200.7 |
| Sulfur - T | | 7.42 | | 7.50 | 1 | -1.08% | | EPA 200.7 |
| **Initial Calibration Blank** | | | | | | | | |
| Chloride | | 0.050 | | 0.00 | 1 | 0.05 | (-0.2522) - (0.7472) | SM 4500-Cl E |
| Sulfate | | 1.30 | | 0.00 | 1 | 1.3 | (0.2687) - (2.358) | SM 4500-SO4 E |
| Sulfate | | 1.27 | | 0.00 | 1 | 1.27 | (0.2788) - (2.360) | SM 4500-SO4 E |
| Sulfur - T | | -0.210 | | 0.00 | 1 | -0.21 | | EPA 200.7 |
| **Continuing Calibration Blank** | | | | | | | | |
| Chloride | | 0.370 | | 0.00 | 1 | 0.37 | (-0.0948) - (0.5398) | SM 4500-Cl E |
| Chloride | | 0.400 | | 0.00 | 1 | 0.4 | (-0.0948) - (0.5398) | SM 4500-Cl E |
| Sulfate | | 2.23 | | 0.00 | 1 | 2.23 | (0.1718) - (2.964) | SM 4500-SO4 E |
| Sulfate | | 2.44 | | 0.00 | 1 | 2.44 | (0.1718) - (2.964) | SM 4500-SO4 E |
| Sulfate | | 1.44 | | 0.00 | 1 | 1.44 | (0.0883) - (3.162) | SM 4500-SO4 E |
| Sulfate | | 2.70 | | 0.00 | 1 | 2.7 | (0.0883) - (3.162) | SM 4500-SO4 E |
| Sulfur - T | | -0.210 | | 0.00 | 1 | -0.21 | | EPA 200.7 |

Approved By: Eric Fischer

Approved On: 10/04/2022 11:23 AM

MIDCONTINENT
LABORATORIES, INC.

# CHAIN OF CUSTODY RECORD

2381 S. Plaza Dr. • P.O. Box 3388 • Rapid City, SD 57709
(605) 348-0111 • www.TheChemistryLab.com

| | |
|---|---|
| Company | FMG Inc |
| Project Name / Mgr. | EAFB WFT / Alex Fisher |
| Project Number | 211018 |
| Sampled by | Signature |
| Sampled by | Print RYAN W Cox |

| FOR LAB USE ONLY | |
|---|---|
| Seal Intact (Y/N)/Number | |
| Sample Condition | |
| Temperature of Container | |

| REQUESTED TURN AROUND | |
|---|---|
| STANDARD | RUSH |

| | SAMPLE NAME | DATE | TIME | MATRIX | NO. OF CONTAINERS | PRESERVED WITH | FILTERED (Y/N) | REFRIGERATED (Y/N) | ANALYSES REQUESTED: pH | Cl⁻ | SO4²⁻ | Redox | S²⁻ | COMMENTS | LAB # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | G8A 702 | 1100 | 9/14/22 | | 1 | | | | X | X | X | X | X | | |
| 2 | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | |
| 5 | Batch 7 | | | | 9-14-22 | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | |
| 11 | | | | | | | | | | | | | | | |
| 12 | | | | | | | | | | | | | | | |

| RELINQUISHED BY (Signature) | COMPANY NAME | DATE | TIME | RECEIVED BY (Signature) | COMPANY NAME | DATE | TIME |
|---|---|---|---|---|---|---|---|
| | FMG inc | 9/14/22 | 1135 | | MOT | 9/14/22 | 11:35 |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

FORM 113D

MIDCONTINENT TESTING LABORATORIES

# SAMPLE RECEIPT CHECKLIST

Company Name FMC  Date/Time Received 9-14-22 (Date) / 1135 (Time)

Project EAFB WFT  Received by Dean Brainerd

Lab Number(s) 702 9-14-22  Carrier Name Ryan Cos

| Yes | No | UNPACKING | Initials |
|---|---|---|---|
| ☐ | ☐ | 1. Shipping container in good condition? Hand | |
| ☐ | ☐ | 2. Custody seals present on shipping container? Condition: Intact ☐ Broken ☐ MS | |
| ☐ | ☑ | 3. Ice / Blue Ice (circle one) present in shipping container? Container(s) Temp. 1. MS 2. _____ 3. _____ 4. _____ | |
| ☐ | ☑ | 4. Bottles broken and/or leaking? (Photograph broken bottles.) | |
| ☐ | ☐ | 5. Custody seals on sample bottles? Condition: Intact ☐ Broken ☐ MS | |

| Yes | No | LABELING | Initials |
|---|---|---|---|
| ☑ | ☐ | 6. Chain of custody Present? | |
| ☑ | ☐ | 7. Chain of custody includes signatures, dates, and times when relinquished and received? | |
| ☑ | ☐ | 8. Chain of custody agrees with bottle count? | |
| ☑ | ☐ | 9. Chain of custody agrees with labels? | |
| ☑ | ☐ | 10. Samples received within holding times? | |
| ☑ | ☐ | 11. Samples in proper container? | |
| ☑ | ☐ | 12. Sufficient sample volume for indicated tests? | |

## PRESERVATIVE

| Yes | No | | Initials | Yes | No | | Initials |
|---|---|---|---|---|---|---|---|
| ☐ | ☐ | 13. Metals bottle(s) pH < 2? | | ☐ | ☐ | 17. TOC bottle(s) pH < 2? | |
| ☐ | ☐ | 14. Nutrient bottle(s) pH < 2? | | ☐ | ☐ | 18. Oil & Grease bottle(s) pH < 2? | |
| ☐ | ☐ | 15. Cyanide bottle(s) pH > 12? | | ☐ | ☐ | 19. Volatiles pH < 2? | |
| ☐ | ☐ | 16. Sulfide bottle(s) pH > 9? | | | | | |

**COMMENTS:** _____

F:\Inorganic Forms\SAMPLE RECEIPT CHECKLIST.doc

| FMG Engineering<br>3700 Sturgis Road<br>Rapid City, SD 57702<br>605-342-4105 | Laboratory Measurement of Soil Resistivity Using the Soil Box Method<br>*ASTM G 57* |
|---|---|

| | | | |
|---|---|---|---|
| **Project Number:** | 221204 | **Date Performed:** | 23-Sep-22 |
| **Client:** | Jacobs | **Performed By:** | JTL |
| **Project Name:** | Weapons Loader Training - EAFB | **Performed By:** | RC |
| **Sample Location:** | As noted | **Type:** | Micropiles |

| Sample Location | Depth (ft) | Initial Meter Reading | Meter Reading Multiplier | Final Reading (ohms) | Soil Resistivity (ohms-cm) | Risk Assessment or Soil Corrosivity Zone | Corrosivity Rating |
|---|---|---|---|---|---|---|---|
| P2C | **20-21.5'** | 1.6 | 1000 | 1600 | **1600** | **N/A** | **Highly Corrosive** |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

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# APPENDIX B – LIMITED REGULATION BUILDING MATERIALS SURVEY, PRIDE HANGAR B7504 (FOR INFORMATION ONLY)

## B-21: WEAPONS LOADER TRAINING (WLT) FACILITY
## PNFXBM23180 (FY23)

## ELLSWORTH AFB, SOUTH DAKOTA

PREPARED BY:
U.S. Army Corps of Engineers, Omaha District

*BUILDING STRONG*

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# Limited Regulated Building Materials Survey

Pride Hanger
Building B7504
Ellsworth Air Force Base, South Dakota
Terracon Project No. 24217029
November 5, 2021

**Prepared for:**
Jacobs Engineering
Houston, Texas

**Prepared by:**
Terracon Consultants, Inc.
Cheyenne, Wyoming

terracon.com
Terracon
Environmental • Facilities • Geotechnical • Materials

November 5, 2021

Jacobs Engineering
2224 Bay Area Boulevard
Houston, Texas 77058-2008

Attn: Thomas F. Marti, CDT, LEED AP BD+C
Jacobs, Senior Project Manager
thomas.marti@jacobs.com
P: (618) 407-3254

RE: Limited Regulated Building Materials Survey Report
Building B7504 (Pride Hanger) Project No. FXBM223909
Ellsworth Air Force Base, South Dakota 57706
Terracon Project No. 24217029

Dear Mr. Marti:

Terracon Consultants, Inc. (Terracon) was contracted by Jacobs Engineering (Client) to conduct a Limited Regulated Building Materials survey for Building B7504 (Pride Hangar), Ellsworth Air Force Base, South Dakota. This survey was conducted in accordance with Terracon proposal No. P24217029 dated May 19, 2021. We understand that these services were requested due to the planned renovation of the building.

Asbestos-containing materials (ACM), lead paint (LP), polychlorinated biphenyls (PCBs), and radon were identified in the building. Please refer to the attached report for details.

Terracon appreciates the opportunity to provide this service to Jacobs Engineering. If you have any questions regarding this report, please contact the undersigned at (307) 632-9224.

Sincerely,
**Terracon Consultants, Inc.**

*Prepared By:*

Brian K. Ramsell
Project Manager
*South Dakota Certified Inspector #8835*

*Reviewed By:*

Rush Bowers, CIH, CSP
Senior Industrial Hygienist

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# EXECUTIVE SUMMARY

Terracon Consultants, Inc. (Terracon) conducted a Regulated Building Materials (RBM) survey for Building B7504 (Pride Hangar), Ellsworth Air Force Base, South Dakota. The RBM survey included a limited asbestos inspection, a lead paint (LP) inspection, and Polychlorinated Biphenyls (PCBs) testing for project areas planned for renovation. Additionally, radon testing was included for areas of planned occupancy, and testing for elemental mercury for the rubberized indoor track was conducted. These services were conducted in accordance with Terracon proposal No. P24217029 dated May 19, 2021. The RBM survey was performed between August 31, 2021 and September 2, 2021.

The RBM survey was limited to the project areas of Pride Hanger as identified on the Planning Charrette Report drawings (*Demolition East and West Elevations, pages AD101 to AD202 dated April 1, 2021, Jacobs Engineering and US Army Corps of Engineers*) provided by Jacobs Engineering.

The following asbestos-containing materials (ACM) were identified in project areas as a result of laboratory analysis or were assumed to be ACM:

- 9-inch Green Vinyl Floor Tile w/ Black and Cream Streaks
- White Taping Mud associated with Painted 5/8" White Drywall
- Black Woven Electrical Wiring
- Metal Fire Door
- Metal Fire Door (Sliding Door)

The following material was identified in project areas as containing 1% asbestos or less as the result of laboratory analysis.

- Gray Window Glazing

Lead was detected in painted building components as a result of the X-ray fluorescence (XRF) screening and laboratory analysis.

Concentrations of PCBs in bulk samples of window glazing and window caulk samples collected from the project areas were reported below the United States Environmental Protection Agency (USEPA) PCB regulatory limit of 50 parts per million (ppm) as the result of laboratory analysis.

Total mercury content of the rubberized indoor track in the hangar was below the USEPA Resource Conservation and recovery Act (RCRA) regulatory limit of 260 milligrams per kilogram (mg/kg) as the result of laboratory analysis.

Radon concentrations were below the American Association of Radon Scientists and Technologists and American National Standards Institute (AARST-ANSI) protocol for large buildings and schools recommended action level of 4.0 pCi/L as a result of laboratory analysis.

# LIMITED REGULATED BUILDING MATERIALS SURVEY
# BUILDING 750 PRIDE HANGAR
# ELLSWORTH AFB, SOUTH DAKOTA

**November 5, 2021**

## 1.0 INTRODUCTION

Terracon Consultants, Inc. (Terracon) conducted a Regulated Building Materials (RBM) survey for Building B7504 (Pride Hangar), Ellsworth Air Force Base, South Dakota. The RBM survey included a limited asbestos inspection, a lead paint (LP) inspection, and PCB testing for planned renovation areas. Additionally, radon testing was included for areas of planned occupancy, and testing for elemental mercury for the rubberized indoor track was conducted. These services were conducted in accordance with Terracon proposal No. P24217029 dated May 19, 2021. The RBM survey was performed between August 31, 2021 and September 2, 2021.

### 1.1 Project Objective

The RBM survey was limited to the project areas of Pride Hanger as identified on the Planning Charrette Report drawings (*Demolition East and West Elevations, pages AD101 to AD202 dated April 1, 2021, Jacobs Engineering and US Army Corps of Engineers*) provided by Jacobs Engineering.

The asbestos survey was conducted in project areas to satisfy the requirements of the United States Environmental Protection Agency (USEPA) 40 Code of Federal Regulations (CFR) Part 61 National Emission Standards for Hazardous Air Pollutants (NESHAP), Subpart M. At the client's request, the asbestos survey did not include the roof. The survey did not include destructive investigation to inspect wall cavities or other concealed areas. The asbestos survey was performed on August 31, 2021 and September 1, 2021 by AHERA[1]-accredited and State of South Dakota-certified asbestos inspectors in accordance the sampling protocols established in USEPA 40 CFR Part 763-Asbestos, Subpart E-Asbestos-Containing Materials in Schools (known as AHERA).

The LP inspection was conducted project areas to provide information for compliance with United States Occupational Health and Safety Administration (USOSHA) 29 CFR 1910.1025 Lead and 29 CFR 1926.62 Lead. The LCP survey not intended to meet the requirements of the U.S. Department of Housing and Urban Development (HUD) *Guidelines for the Evaluation and Control of Lead-Based Paint (LBP) Hazards in Housing* or the USEPA Resource Conservation and Recovery Act (RCRA) for waste determination. The LP inspection was performed on August 31, 2021 utilizing the testing and sampling protocols established in the HUD *Guidelines for the*

[1] Asbestos Hazard Emergency Response Act

*Evaluation and Control of Lead-Based Paint Hazards in Housing*, *Chapter 7 (2012 revision)* including x-ray fluorescence (XRF) testing as a screening tool and paint chip sampling.

The Polychlorinated biphenyls (PCBs) testing was conducted to provide information for compliance with USEPA 40 CFR Part 761 PCBs.

The elemental mercury testing was conducted to provide information for compliance with USEPA Resource Conservation and Recovery Act (RCRA).

The radon testing was conducted to provide information for determining system needs for radon mitigation. Radon testing was conducted in rooms located on the ground level to the east and west sides of the hangar.

### 1.2 Reliance

This report is for the exclusive use of Jacobs Engineering for the project being discussed. No other individual or entity may rely on this report without written permission of Terracon and Jacobs Engineering. Reliance on this report by Jacobs Engineering and all authorized parties will be subject to the key understandings and limitations stated in the proposal, this report, and our Master Services Agreement. The limitation of liability defined in the Master Services Agreement is the aggregate limit of Terracon's liability to Jacobs Engineering and all relying parties.

### 1.3 General Conditions and Limitations

The RBM survey was conducted based on information provided to Terracon regarding the condition of the building. The level of effort and associated tasks completed for this assessment were limited to the scope of, and as provided within the parameters and defined limitations of, our proposal dated March 19, 2021. Terracon did not attempt to identify every potential exposure or hazard present in the subject building. The results, findings, conclusions, and recommendations expressed in this report are based on observations, assessments, and testing conducted from August 31 through September 2, 2021.

## 2.0 BUILDING DESCRIPTION

Pride Hangar is a reinforced concrete ribbed barrel vault shell structure with slab-on-grade foundation and non-functional steel structure hangar doors on the north and south ends of the hangar. The walls of the saddlebag buildings along the east and west sides of the hangar are reinforced concrete or concrete masonry unit (CMU) block. The hangar encompasses approximately 125,649 square feet and was built in 1945.

The interior finishes of the saddlebag buildings include bare concrete, carpeting, vinyl floor tile, and ceramic floor tile floors; bare concrete, CMU block, and/or gypsum drywall walls; and bare concrete, lay-in ceiling panel or gypsum drywall ceilings.

The hangar and the east saddlebag building did not have any observable installed heating or cooling systems. The finished spaces of the west saddlebag building were heated and cooled with ceiling-recessed, split-type, heat pump air conditioners connected to an outdoor condenser unit.

Terracon labeled the rooms to identify functional spaces and sample locations. The room numbers are listed in the table below.

| Building Area | Room # | Description | Building Area | Room # | Description |
|---|---|---|---|---|---|
| Hangar | 100 | Hangar | West Saddlebag | 115 | Women's Restroom |
| Hangar | 100A | Electrical Room | West Saddlebag | 116 | Women's Locker Rm |
| West Saddlebag | 101 | Vacant Space | West Saddlebag | 117 | Men's Locker Rm |
| West Saddlebag | 101A | Storage Closet | West Saddlebag | 118 | Men's Restroom |
| West Saddlebag | 101B | Vacant Room | West Saddlebag | 119 | Office |
| West Saddlebag | 102 | Visitor Room | West Saddlebag | 120 | Office |
| West Saddlebag | 103 | Storage | Hangar | 121 | Vacant Space |
| West Saddlebag | 104 | HG* Game Room | West Saddlebag | 122 | Vestibule |
| West Saddlebag | 105 | HG Ready Room | East Saddlebag | 123 | Vacant Room |
| West Saddlebag | 106 | HG Office | East Saddlebag | 123A | Vacant Room |
| West Saddlebag | 107 | HG Office | East Saddlebag | 124 | Vacant Room |
| West Saddlebag | 108 | HG Hallway | East Saddlebag | 125 | Vacant Room |
| West Saddlebag | 109 | HG Storage Room | East Saddlebag | 125A | Storage Room |
| West Saddlebag | 110 | Utility Room | East Saddlebag | 126 | Vacant Room |
| West Saddlebag | 111 | Utility Room | East Saddlebag | 127 | Vacant Storage Rm |
| West Saddlebag | 111A | Utility Storage | East Saddlebag | 128 | Storage Room |
| West Saddlebag | 112 | Utility Room | East Saddlebag | 129 | Vacant Room |
| West Saddlebag | 113 | Utility Storage | East Saddlebag | 130 | Vacant Room |
| West Saddlebag | 114 | Restroom | East Saddlebag | 131 | Vacant Room |
| West Saddlebag | 114A | Restroom Storage | East Saddlebag | 132 | Vacant Room |
| West Saddlebag | 114B | Restroom Utility | Hangar | 133 | Vacant Space |

*HG = Honor Guard

Rooms that were not accessible during the survey included Rooms 111A, 113, 119, 120, 125, and 128. Attempts were made by Terracon's AFB site contact to access these rooms during the survey but access was not achieved by the completion of the RBM survey. A drawing of the floor plan is presented in Appendix H.

# 3.0 FIELD ACTIVITIES

The asbestos survey was conducted August 31 to September 1, 2021 by Mr. Brian Ramsell and Mr. Mike Fera, AHERA-accredited and State of South Dakota-certified asbestos inspectors. Copies of Mr. Ramsell's and Mr. Fera's asbestos inspector accreditations and certifications can be found in Appendix J. A summary of survey activities is provided below.

## 3.1 Asbestos

### 3.1.1 Visual Assessment

Survey activities were initiated with visual observation of the project areas within the hangar and saddlebag buildings to identify and document homogeneous areas of suspect ACM. A homogeneous area (HA) consists of building materials that appear similar throughout in terms of color and texture with consideration given to the date of application. Although reasonable effort was made to survey accessible suspect materials, additional suspect but unsampled materials could be located in voids or in other concealed areas.

Should suspect materials other than those which were identified during this survey are uncovered during renovation or demolition activities, those materials should be assumed asbestos-containing until sampling and analysis can confirm the presence or absence of asbestos.

Non-textured wallboard systems were observed in Rooms 101, 102, 103, 104, 105, 106, 107, 108, 109, 109A, 114, 114B, 115, 117, and 118.

### 3.1.2 Suspect ACM and Non-Suspect Materials

Terracon identified a total of 31 homogenous areas of suspect ACM (including three assumed ACMs).

Non-suspect materials in the project areas included carpet, wood paneling, Masonite paneling, metal suspended ceiling grid system, white mineral wool insulation above suspended ceilings, and yellow fiberglass pipe insulation. Glass-paned windows in Rooms 129, 130, 131, and 132 were sealed with non-suspect silicone sealant.

A summary of suspect ACM samples collected during the survey can be found in Appendix B Photographs of suspect ACM can be found in Appendix I.

### 3.1.3 Physical Assessment

A physical assessment of each HA of known and suspect ACM was conducted to assess the friability and condition of the materials. A friable material is defined by the USEPA as a material

that can be crumbled, pulverized, or reduced to powder by hand pressure when dry. Friability was assessed by physically touching suspect materials.

### 3.1.4 Sample Collection

Based on results of the visual observation, bulk samples of newly identified suspect ACM were collected in accordance with the sampling protocols outlined in 40 CFR Part 763, Subpart E. Samples of suspect materials were collected from randomly selected locations in each HA. Bulk samples were collected using wet methods, as applicable, to reduce the potential for fiber release. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker.

Sample locations were determined using a random number generator and numerical grids in accordance with sampling techniques suggested in the AHERA training model accreditation program. The selection of samples locations and frequency of sampling were based on Terracon's observations and the assumption that like materials in the same area are homogeneous in content.

Terracon collected 84 samples from 28 homogenous areas of suspect ACM from the project areas. A summary of the classification, assessment category, and approximate quantity of identified ACM can be found in Appendix A. A summary of suspect ACM samples collected during the survey can be found in Appendix B. Sample location diagrams can be found in Appendix H. Photographs of suspect ACM can be found in Appendix I.

### 3.1.5 Sample Analysis

The inspector shipped the samples along with a completed chain-of-custody (COC) to the laboratory. The laboratory then arranged the samples in numerical order. If a discrepancy between the samples exists, this is noted and initialed on the log sheet. The laboratory signed a copy of the chain-of-custody to acknowledge receipt. The inspector retained the signed copy for evidentiary purposes. Further, the laboratory assigned a laboratory number to each sample received. The laboratory labeled both the analytical report and the sample container with this laboratory number for cross-reference purposes.

Asbestos bulk samples were submitted under chain of custody COC to Eurofins EMLab P&K in Arvada, South Dakota for analysis by polarized light microscopy (PLM) with dispersion staining techniques in accordance with USEPA's *Method for the Determination of Asbestos in Bulk Building Materials* (600/R-93/116). The asbestos content, if present, was determined by microscopic visual estimation. Aerotech Laboratories, Inc is accredited under the National Voluntary Laboratory Accreditation Program (NVLAP) Accreditation No. 500031-0. The laboratory report and COC are provided in Appendix B.

NESHAP requires that any analytical detection of asbestos by PLM less than 10% must be assumed to contain greater than 1% unless analysis by PLM point count proves that the samples contained less than or equal to 1% asbestos. Point count analysis was not requested for any of the samples submitted to the laboratory.

## 3.2 Lead Paint

### 3.2.1 Visual Assessment

The LP inspection was conducted August 31, 2021 by Mr. Brian Ramsell. A summary of inspection activities is provided below. The LP inspection consisted of a visual and physical assessment, testing with an X-ray fluorescence (XRF) analyzer, and the collection of representative surface coatings (i.e., paint chips) the XRF could not conclusively determine to be lead-containing for laboratory analysis of lead content.

### 3.2.2 Visual Assessment

Terracon's inspection activities began with visual observation of project areas within the hangar to identify all testing combinations of painted surfaces in each room equivalent (e.g., room, hallway, foyer, etc.). A testing combination is characterized by the room equivalent, the component type, and the substrate. A component is defined as a particular item, such as doors, windows, walls, etc. Substrates are classified as brick/masonry, concrete, drywall, metal, plaster, or wood. Painted surfaces include any surface coated with paint, shellac, varnish, stain, paint covered by wallpaper, or any other coating. Terracon compiled an inventory of testing combinations and documented the general location of the materials.

### 3.2.3 Physical Assessment

A physical assessment of each unique combination of paint in the areas assessed was conducted to assess the condition of the paint. Paint was visually assessed and assigned a condition of intact, fair or poor.

### 3.2.4 XRF Testing

Based on results of the visual assessment, Terracon obtained XRF measurements from at least one representative testing combination in each room equivalent in the areas assessed. When using testing combinations, lead paint results are classified by summing the individual component test results of positive, negative, or inconclusive. Results are reported in milligrams per square centimeter ($mg/cm^2$). For the purpose of this project, paint or coatings with XRF results greater than none detected (or 0.0 $mg/cm^2$), are considered to contain detectable lead. Terracon collected 143 XRF measurements from painted building components and collected one paint chip sample representing painted gypsum drywall walls that tested none detected by XRF.

For more detailed information including testing location, component, color, and substrate, refer to the XRF inspection table in provided in Appendix C.

### 3.2.5 XRF Instrumentation

The Olympus Vanta VCR Series Handheld X-Ray Fluorescence (XRF) analyzer (Serial Number 803633) was operated in the "Lead Paint Mode" for this project. The instrument was used in general accordance with HUD inspection guidelines and the procedures detailed in Chapter 3 of the manufacturer's Instruction Manual, Vanta Family X-Ray Fluorescence Analyzer (DMTA-10072-01En – Rev. F, April 2020). According to HUD guidelines, a lead measurement requires that a reading be taken with a 95% confidence level. This means that the actual measured lead value must exceed the regulatory action level by at least twice the uncertainty value to be considered valid. Uncertainty is not a constant value; it depends on time, measurement, substrate, and the actual lead concentration. The Olympus Vanta VCR Series Handheld XRF in Lead Paint Mode automatically, incorporates all of these factors to yield 95% confidence readings. Laboratory analysis is considered a more definitive procedure and those results supersede the XRF results. Laboratory results are either expressed as a weight percent if a chip sample was collected without measuring the surface area of the sample, or as a weight per area if a specific area of paint was sampled. Lead-based Paint (LBP) is defined by laboratory results of $\geq$ 0.5% by weight or by XRF readings $\geq$ 1.0 mg/cm$^2$.

No substrate correction is recommended for brick, concrete, drywall, metal, plaster, or wood when the Olympus Vanta VCR Series Handheld XRF is operated in the Lead Paint Mode.

Calibration of the Olympus Vanta VCR Series Handheld XRF is performed by the manufacturer. This calibration involves measurement of known lead films (NIST reference standards) placed on different building material substrates. The data from the resultant spectra are incorporated into a mathematical function. This function, a component of proprietary software, is used to calculate concentrations of lead.

The accuracy of the field measurement depends on three factors. The first is the quality of the reference standard lead film prepared by NIST. The second factor is accuracy of the mathematical function, that is, the difference between the calculated concentrations and actual concentrations. Third, the similarity between the building material samples used during calibration and the building materials encountered in the field can impact the accuracy of the measurement.

In-field calibration checks are performed at least twice daily, once prior to the inspection and once immediately after the inspection (see XRF inspection table in Appendix A for calibration results), using protocols provided by HUD and the instrument manufacturer according to the NIST reference standard.

### 3.2.6 Sample Collection

Paint or coatings with XRF measurements of greater than 0.0 mg/cm$^2$ (or none detected) were considered to contain detectable lead. Representative paint chip samples were collected for paint combinations in which XRF results were not greater than 0.00 mg/cm$^2$ or were inconclusive, since USOSHA does not accept negative or inconclusive XRF results. For example, if a paint combination consisting of walls with white paint and drywall substrate in several rooms were 0.00 mg/cm$^2$ by XRF, then one representative paint chip sample for that paint combination was collected for laboratory analysis.

Paint chip samples included all layers of paint with care taken to minimize collection of the substrate. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker. This number (along with other information such as sample location, color, substrate, and condition) was recorded in the sample log.
The inspector shipped the samples along with a completed chain-of-custody (COC) document to the laboratory. The laboratory then arranged the samples in numerical order. If a discrepancy between the samples exists, this is noted and initialed on the log sheet. The laboratory signed a copy of the chain-of-custody to acknowledge receipt. The inspector retained the signed copy for evidentiary purposes. Further, the laboratory assigned a laboratory number to each sample received. The laboratory labeled both the analytical report and the sample container with this laboratory number for cross-reference purposes.

For more detailed information including testing location, component, color, and substrate, refer to the XRF inspection table in provided in Appendix C.

### 3.2.7 Laboratory Analysis

The inspector shipped the paint chip samples along with a completed COC to the laboratory. The laboratory then arranged the samples in numerical order. If a discrepancy between the samples exists, this is noted and initialed on the log sheet. The laboratory signed a copy of the chain-of-custody to acknowledge receipt. The inspector retained the signed copy for evidentiary purposes. Further, the laboratory assigned a laboratory number to each sample received. The laboratory labeled both the analytical report and the sample container with this laboratory number for cross-reference purposes.

The paint chip samples were submitted under COC to EMSL Analytical, Inc. (EMSL)of Indianapolis, Indiana for analysis by flame atomic absorption spectrophotometry (AAS) in accordance with USEPA SW-846 Methods 3050B/7000B *Acid Digestion of Sediments, Sludges, and Soils / Flame Atomic Absorption Spectrophotometry*. EMSL is accredited by the AIHA® Laboratory Accreditation Programs, LLC under the Industrial Hygiene Laboratory Accreditation Program (IHLAP; Accreditation No. 157245). The laboratory report and COC are provided in Appendix D.

## 3.3 PCBs

PCB testing was conducted September 1, 2021, by Mr. Brian Ramsell and Mr. Mike Fera. The PCB inspection was completed in accordance with applicable federal regulations with the objective being to document the presence of PCBs in window glazing and window caulk in the project areas that would likely be disturbed during renovation efforts.

Based on results of the visual observations, bulk samples of suspect PCB-containing materials were collected in accordance with USEPA sampling protocols. Samples were placed in sealable containers and labeled with unique sample numbers using an indelible marker. Terracon collected two bulk samples from the project areas including one window glazing and one window caulk. Light ballasts were inspected for PCB labeling.

Bulk samples were submitted under COC to EMSL in Cinnaminson, New Jersey and were analyzed *via* EPA Method SW 846 Method 3540C/8082A. The laboratory report and corresponding COC documentation are enclosed. EMSL is a National Environmental Laboratory Accreditation Program (NELAP)-accredited laboratory (TNI Lab Code TNI01273).

A summary of the PCB sampling and laboratory report are presented in Appendix F.

## 3.4 Elemental Mercury

Elemental mercury testing was conducted September 1, 2021, by Mr. Brian Ramsell and Mr. Mike Fera. The rubberized indoor track was suspected to contain elemental mercury and sampled. The sample was placed in a sealable container and labeled with unique sample numbers using an indelible marker. Terracon collected one composite bulk sample from three random locations of the rubberized indoor track.

Bulk samples were submitted under COC to EMSL in Cinnaminson, New Jersey and were analyzed *via* EPA Method SW 846 Method 3540C/8082A. The laboratory report and corresponding COC documentation are enclosed. EMSL is a National Environmental Laboratory Accreditation Program (NELAP)-accredited laboratory (TNI Lab Code TNI01273).

A summary of the elemental mercury sampling and laboratory report are presented in Appendix E.

## 3.5 Radon

Radon testing was conducted August 31 to September 2, 2021, by Mr. Brian Ramsell and Mr. Mike Fera. The radon testing was conducted based on information provided to Terracon regarding the condition of the building. Factors such as water table levels and building conditions (i.e., cracks developing in the foundation over time, installation of new ventilation systems, etc.) can

affect radon concentrations. Additionally, radon concentrations between different rooms within the same building can vary significantly depending on the subsurface geology of the building area, and structural integrity of the building.

### 3.5.1 Radon Testing

Terracon performed radon screening for the project areas of the hangar's saddlebag buildings from August 31 through September 2, 2021. Radon canisters were placed randomly (approximately one canister per 2,000 square feet of space) throughout the project areas of the hangar's saddlebag buildings. The east saddlebag building area included Rooms 126, 127, 128, 129, 130, 131, and 132, which were unfinished and unoccupied but will be developed with the upcoming project. The west saddlebag building area included Rooms 102, 103, 104, 105, 106, 107, 108, 109, and 109A, which was occupied by the Air Force Honor Guard. The canisters were positioned at least three feet from doors and windows and between two and six feet above the floor surface in the selected locations. In general accordance with the sampling protocols found in the EPA *Protocols for Radon and Radon Decay Product Measurements in Homes*, 1993, one side-by-side duplicate sample was collected at a rate of 10% of all testing locations and one blank sample was collected at a rate of 5% of all testing locations.

### 3.5.2 Laboratory Analysis

The sample canisters were retrieved within 48 hours after their placement and were submitted under chain of custody to Radon Testing Corporation of America (RTCA) in Elmsford, New York for analysis. Laboratory analysis was completed in accordance with the current EPA protocols for the analysis of radon in air (EPA 402-R-92-004 *Indoor Radon and Radon Decay Product Measurement Device Protocols, July 1992*).

# 4.0 REGULATORY OVERVIEW

## 4.1 Asbestos

The South Dakota Department of Environment and Natural Resources (SDENR) incorporates the Asbestos NESHAP by reference in the Administrative Rules of South Dakota 74:36:08:02. The facility owner or operator must provide SDENR with written notification at least 10 working days prior to the commencement of renovation or demolition activities, even if asbestos is not present. Asbestos abatement activities must be reported in the notification for projects that will disturb RACM in amounts greater than to 160 square feet or 260 linear feet. The notification form includes providing information on non-friable ACM to be removed or left in place and requires the name of the inspector.

The asbestos NESHAP (40 CFR Part 61, Subpart M) regulates asbestos fiber emissions and asbestos waste disposal practices. The asbestos NESHAP regulation also requires the identification and classification of existing ACM according to friability prior to demolition or renovation activity. Friable ACM is a material containing more than 1% asbestos that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure. All friable ACM is considered regulated asbestos containing material (RACM).

The asbestos NESHAP regulation classifies material subject to demolition or renovation as either RACM, Category I non-friable ACM, or Category II non-friable ACM. RACM includes all friable ACM (pre-disturbance), along with Category I non-friable ACM that becomes friable (during disturbance), and Category I non-friable ACM subject to sanding, grinding, cutting, or abrading, or Category II non-friable ACM with a high probability of becoming crumbled, pulverized, or reduced to powder by forces expected to act on the material during disturbance. Category I non-friable ACM are exclusively asbestos-containing packings, gaskets, resilient floor coverings, and asphalt roofing products that contain more than 1% asbestos. Category II non-friable ACM are all other non-friable materials (other than Category I non-friable ACM) that contain more than 1% asbestos. Category II non-friable ACM generally includes (but is not limited to) cementitious material such as: cement pipes, cement siding, cement panels, glazing, mortar, and grouts.

The USOSHA asbestos standard for construction (29 CFR 1926.1101) regulates workplace exposure to asbestos. The USOSHA standard requires that employee exposure to airborne asbestos must not exceed 0.1 fibers per cubic centimeter of air (0.1 f/cc) as an eight-hour time weighted average (TWA) and not exceed 1.0 f/cc over a 30-minute time period known as an excursion limit (EL). The TWA and EL are known as USOSHA's asbestos permissible exposure limits (PELs). The USOSHA standard classifies construction and maintenance activities that could disturb ACM and specifies work practices and precautions that employers must follow when engaging in each class of regulated work. The standard also specifies requirements for handling materials containing asbestos at concentrations less than or equal to one percent.

## 4.2 Lead Paint

The USOSHA Lead Standard for Construction (29 CFR 1926.62) applies to all construction work where an employee may be occupationally exposed to lead. All work related to construction, alteration or repair (including painting and decorating) is included. The lead-in-construction standard applies to any detectable concentration of lead in paint, as even small concentrations of lead can result in unacceptable employee exposures depending upon on the method of removal and other workplace conditions. Under this standard, construction includes, but is not limited to, the following:

- Demolition or salvage of structures where lead or materials containing lead are present;
- Removal or encapsulation of materials containing lead;
- New construction, alteration, repair, or renovation of structures, substrates, or portions containing lead, or materials containing lead;
- Installation of products containing lead;
- Lead contamination/emergency clean-up;
- Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed; and
- Maintenance operations associated with construction activities described above.

Employers must assure that no employee will be exposed to lead at concentrations greater than 50 micrograms per cubic meter ($\mu g/m^3$) averaged over an eight-hour period without adequate protection. The USOSHA standard also establishes an action level of 30 $\mu g/m^3$, which if exceeded, triggers certain requirements, including periodic exposure monitoring and medical monitoring.

HUD issued the Guidelines for the Evaluation and Control of Lead Based Paint Hazard in Housing pursuant to Section 1017 of the Residential Lead-Based Paint Hazard Reduction Act of 1992, which is often referred to as Title X ("Title Ten") because it was enacted as Title X of the Housing and Community Development Act of 1992 (Public Law 102-550). The 2012 second edition of the Guidelines replaced the 1995 edition, with its LBP inspection chapter revised in 1997. The Guidelines apply to lead hazard evaluation and control in all federally associated housing and provide information on conducting renovations in older housing, lead-based paint inspections and risk assessments. The Guidelines complement regulations that have been issued by HUD, the USEPA, USOSHA, and policies from the Centers for Disease Control and Prevention (CDC).

The USEPA/HUD action level for lead-based painted surfaces is 1.0 $mg/cm^2$ using the XRF method, or 0.5% dry weight using the atomic absorption analytical method. The HUD/USEPA definition of LBP is directed at protecting the general population from exposure to lead in the residential setting. By contrast, the duty of USOSHA is to protect workers during construction activities that may generate elevated airborne lead concentrations. USOSHA states that construction work (which includes renovation, maintenance, and demolition) carried out on structures coated with paint that

has lead concentrations lower than the HUD/USEPA regulatory limits can still result in airborne lead concentrations in excess of regulatory limits.

USEPA regulates disposal of hazardous materials. The USEPA has stated that components removed with intact LBP that is not delaminating from the substrate may be disposed as general demolition debris. If the LBP is stripped from components, or if it is delaminating from the substrate, the waste may be subject to hazardous waste rules [i.e., Toxicity Characteristics Leaching Procedure (TCLP)].

The Resource Conservation and Recovery Act (RCRA) gave the USEPA authority to regulate the waste status of demolition and renovation debris, including lead-containing materials. Specific notification and testing requirements must be addressed prior to transporting, treating, storing, or disposing of hazardous wastes. Lead-containing wastes are considered hazardous waste under RCRA if Toxicity Characteristic Leaching Procedure (TCLP) results exceed 5 milligrams per liter (mg/L). USEPA exempts from most RCRA requirements for those generators whose combined hazardous waste generation is less than 100 kilograms (kg) per month. The USEPA has stated that components removed with intact LBP that is not delaminating from the substrate may be disposed as general demolition debris. If the LBP is stripped from components, or if it is delaminating from the substrate, the waste may be subject to hazardous waste rules (i.e., TCLP).

### 4.3 Radon

Geologic materials that contain naturally occurring uranium are potential sources of radon gas that can seep into homes and buildings and accumulate in elevated concentrations. Radon can be found in high concentrations in soils and rocks containing uranium, such as granite, shale, phosphate, and pitchblende. Locations of these materials are highly unpredictable. Elevated levels of radon may also be found in soils contaminated with certain types of industrial wastes, such as the by-products from uranium or phosphate mining. Radon can accumulate inside structures at concentrations that may pose risks to human health. Indoor radon levels are influenced by building construction and the concentration of radon in the underlying soil. The United States Environmental Protection Agency (USEPA) recommends an action level of 4.0 picocuries of radon per liter of air (pCi/L) in structures throughout the United States. According to radon maps prepared by the USEPA, the evaluated office building is located in Radon Zone 1 (counties with predicted average indoor radon screening levels greater than 4 pCi/L).

## 5.0 FINDINGS

### 5.1 Asbestos

Materials containing greater than 1% asbestos are considered to be asbestos-containing materials (ACM) in accordance with USEPA NESHAP and USOSHA Asbestos in Construction Standard. However, USOSHA regulates exposure to any detectable level of asbestos.

The following materials were identified in project areas as ACM as the result of laboratory analysis.

| HA No. | Mat'l Code | Material Description | % and Type Asbestos | Homogenous Area Location | Estimated Quantity[2] |
|---|---|---|---|---|---|
| 05 | FT1 | 9-inch Green Vinyl Floor Tile with Black and Cream Streaks* | 10% Chrysotile | Room 101 | 16 SF |
| 02 | WB1 | White Taping Mud associated with Painted 5/8" White Drywall | 2% Chrysotile | Room 129, North Wall over Door | 8 SF |

*Laboratory analysis indicated that no asbestos was detected in the associated black mastic.

The following materials within the project areas were assumed to be ACM or contain ACM.

| HA No. | Mat'l Code | Material Description | Homogenous Area Location | Estimated Quantity |
|---|---|---|---|---|
| 29 | WP6 | Black Woven Electrical Wiring | Room 112 (on ground and assumed in some electrical fuse boxes and associated conduit) | 60+ LF |
| 30 | FD1 | Metal Fire Door | Rooms 100, 100A, 101B, 102, 108, 111, 112, 117, 120, 121, 125, 132, and 133 | 25 EA |
| 31 | FD1 | Metal Fire Door (Sliding Door) | Rooms 111, 113, and 127 | 3 EA |

[2] **Estimated quantities** are based on a cursory field evaluation, and actual quantities may vary significantly, especially if asbestos-containing materials are present in hidden and/or inaccessible areas not evaluated as part of this survey. SF = Square Feet; LF = Linear Feet; EA = Each.

The following materials were identified in the project areas as containing 1% asbestos or less as the result of laboratory analysis.

| HA No. | Mat'l Code | Material Description | % and Type Asbestos | Homogenous Area Location | Estimated Quantity |
|---|---|---|---|---|---|
| 28 | SC1 | Gray Window Glazing | <1% Chrysotile | Room 100 (windows on hangar doors) and Room 112 (windows) | 1,820 SF |

A summary of the locations, conditions, and approximate quantities of identified ACM and trace materials are presented in Appendix A. The summary of sample locations and laboratory report are presented in Appendix B.

## 5.2 Lead Paint

USOSHA regulates exposure to any detectable level of lead as provided in the USOSHA Lead in Construction Standard (29 CFR 1926.62). An XRF hand held analyzer was used as a screening tool to identify paint and coatings containing lead in project areas. Based on the results of XRF testing, LP was detected during the course of the inspection. Paint with any detectable lead is regulated by USOSHA Lead in Construction Standard. Twenty-seven of the testing combinations were found to have lead concentrations greater than or equal to 1.0 mg/cm$^2$. A summary of the identified areas of LP with lead concentrations greater than or equal to 1.0 mg/cm$^2$ from this inspection is included in the table below.

| Sample Location | Component | Substrate | Color | Condition | Result (mg/cm$^2$) |
|---|---|---|---|---|---|
| Room 100 | Wall Framing | Metal | White | Intact | >5 |
| Room 100 | Wall Panels | Wood | White | Intact | >5 |
| Room 100 | Railing | Metal | Brown | Intact | >5 |
| Room 100 | Stair Stringer | Metal | Brown | Intact | >5 |
| Room 100 | Wall | Metal | White | Intact | >5 |
| Room 100 | Wall | Wood | White | Intact | >5 |
| Room 101 | Wall | Concrete | Pink | Intact | >5 |
| Room 101 | Wall | Concrete | Pink | Intact | 3.03 |
| Room 101 | Wall | Concrete | Pink | Intact | 3.26 |
| Room 101B | Door Frame | Metal | Light Brown | Intact | 3.95 |
| Room 101B | Ladder | Metal | White | Intact | >5 |

| Sample Location | Component | Substrate | Color | Condition | Result (mg/cm$^2$) |
|---|---|---|---|---|---|
| Room 102 | Door Frame | Wood | Brown | Intact | 2.65 |
| Room 108 | Door Frame | Wood | Black | Intact | 3.78 |
| Room 110 | Sliding Door | Metal | Green | Intact | >5 |
| Room 110 | Louvre | Metal | Cream | Intact | 1.71 |
| Room 111 | Door | Metal | Beige | Intact | 3.43 |
| Room 111 | Door Frame | Metal | Beige | Intact | 2.77 |
| Room 111 | Door | Metal | Beige | Intact | >5 |
| Room 129 | Wall | CMU Block | Yellow | Poor | 1.147 |
| Room 129 | Wall | CMU Block | Yellow | Poor | 1.040 |
| Room 129 | Wall | CMU Block | Brown | Poor | 2.17 |
| Room 129 | Wall | CMU Block | Brown | Poor | 4.39 |
| Room 129 | Wall | CMU Block | Brown | Poor | 2.23 |
| Room 130 | Wall | CMU Block | White | Poor | >5 |
| Room 130 | Wall | CMU Block | White | Poor | 4.76 |
| Room 130 | Wall | CMU Block | White | Poor | 4.19 |
| Room 130 | Wall | CMU Block | White | Poor | 4.10 |

The XRF instrument consistently indicated that the paint on interior drywall in the project areas contained no lead. A representative paint chip sample was collected for predominantly white paint on drywall walls. As shown below, a very low lead concentration was identified in the paint chip sample as a result of laboratory analysis.

| Sample Number | Sample Location | Component | Substrate | Color | Condition | Result (mg/kg) |
|---|---|---|---|---|---|---|
| P01 | Room 101 | Wall | Gypsum | White | Intact | 2 |

The XRF inspection table is provided in Appendix C. A summary of the paint chip sampling and laboratory report are presented in Appendix D.

## 5.3 PCBs

Caulk with greater than or equal to 50 parts per million (ppm) PCB is considered PCB bulk product waste in accordance with USEPA Toxic Substances Control Act (TSCA) regulations. Window glazing and window caulk samples collected from the project areas contained PCBs at concentrations below the USEPA PCB regulatory limit of 50 ppm as the result of laboratory analysis.

Before 1979, PCBs were commonly used as insulators in electrical equipment, including fluorescent lamp ballasts. The USEPA banned the use of PCBs in 1979 and required “No PCBs” labeling of newly manufactured ballasts until 1998. Ballasts manufactured through 1979 or if a ballast installed between 1979 and 1998 is not labeled “No PCBs”, it is best to assume it contains PCBs.

One light ballast observed in room 101A appeared to be older than 1998 and was not labeled “No PCBs”. The ballast was assumed to be a PCB-containing ballast. Other light fixtures observed in the project areas were LED back-lit, flat-panel drop ceiling lights and not suspect for PCBs.

A summary of the PCB sampling and laboratory report are presented in Appendix F.

## 5.4 Elemental Mercury

RCRA Land Disposal Restrictions Third Final Rule establishes a high-mercury treatment subcategory for wastes with total mercury content greater than 260 milligrams per kilogram (mg/kg). Flooring containing mercury may be below the mercury concentration limit for the Resource Conservation and Recovery Act (RCRA) control, and some flooring material samples may pass the TCLP (ATSDR 2003a; 2006). Therefore, upon removal, some or all of these polyurethane floors may not be considered hazardous waste.

Total mercury content of the rubberized indoor track in the hangar was below the RCRA regulatory limit of 260 mg/kg as the result of laboratory analysis. The result was 76 mg/kg.

A summary of the elemental mercury sampling and laboratory report are presented in Appendix E.

## 5.5 Radon

Radon was detected as the result of laboratory analysis, as shown below.

| Canister No. | Room | Room Location | Results (pCi/L) |
|---|---|---|---|
| 2967202 | 123 | Vacant, Unfinished Room, East Side | 2.1 |
| 2967182 | 126 | Vacant, Unfinished Room, Center | 3.7 |

| | | | |
|---|---|---|---|
| 2964972 | 131 | Vacant, Unfinished Room, Center | 1.7 |
| 2967189 | 132 | Vacant, Unfinished Room, Center | 1.8 |
| 2967184 | 104 | Honor Guard Game Room, Southwest Corner | 1.6 |
| 2964984 | 105 | Honor Guard Ready Room, Northeast Corner | 1.7 |
| 2965007 | 106 | Honor Guard Office, Southeast Corner | 1.6 |
| 2967204 | 109 | Honor Guard Storage Room North Center | 1.3 |
| 2967181 | 109 | Honor Guard Storage Room North Center (Duplicate Sample) | 1.6 |
| 2967183 | N/A | Blank Sample | 0.1 |

Based on the results of the short-term radon testing conducted at the site, radon concentrations were below the AARST-ANSI recommended action level of 4.0 pCi/L for large buildings. These tests have a laboratory measurement error of plus or minus 0.6 pCi/L.

The radon testing table and laboratory report are presented in Appendix G.

# 6.0 RECOMMENDATIONS

## 6.1 Asbestos

The following materials are a Category I nonfriable ACM under USEPA NESHAP:

- 05-FT1 - 9-inch Green Vinyl Floor Tile with Black and Cream Streaks
  - 10% Chrysotile, Room 101, floor, approximately 16 square feet

According USEPA NESHAP regulations, Category I nonfriable ACM that has become friable or that will be or has been subjected to sanding, grinding, cutting, or abrading, is considered RACM and is required to be removed prior to disturbance by any renovation or demolition activities. Additionally, in the case of demolition, Category I nonfriable ACM need not be removed unless demolition activities will involve intentional scraping, burning, grinding, mechanically chipping, drilling, sand or bead blasting, explosive demolition or other methods that could mechanically powder the material or otherwise render it friable.

The following materials are a Category II nonfriable ACM under USEPA NESHAP:

- 02-FC1 - Painted White Taping Mud associated with 5/8" White Drywall
  - 2% Chrysotile, Room 129, North Wall over Door, approximately 8 square feet

- 29-WP6 – Black Woven Electrical Wiring

  - Assumed ACM, Room 112, (on ground and assumed in some electrical fuse boxes and associated conduit), approximately 60 linear feet

- 30-FD1 – Fire Door
  - Assumed ACM, Rooms 100, 100A, 101B, 102, 108, 111, 112, 117, 120, 121, 125, 132, and 133, approximately 25 each

- 31-FD1 – Fire Door (Sliding Door)
  - Assumed ACM, Rooms 111, 113, and 127, approximately 3 each

According USEPA NESHAP regulations, Category II non-friable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations is considered RACM and is required to be removed prior to disturbance by any renovation or demolition activities.

The following nonfriable materials contain 1% or less (trace) asbestos:

- 28-SC1 – Gray Window Glazing
  - <1% Chrysotile, Rooms 100 (hangar door windows) and Room 112 (windows), approximately 1,100 square feet

The painted drywall joint compound found in Room 129 is considered a nonfriable ACM (since the taping mud is sealed under paint) as an individual layer; however, the composite point count analysis of the drywall system (drywall and taping mud) contained 1% asbestos or less. The USEPA has determined that drywall systems (taping mud, tape, and gypsum drywall) that contain 1% or less asbestos through composite point count analysis, are not considered RACM and are not subject to NESHAP.

However, USOSHA does not permit composite sample analysis and compliance with all applicable USOSHA regulations regarding occupational exposure during renovation or demolition activities is mandatory (removal of drywall systems that contain asbestos is a Class II operation and the employer needs to comply with the appropriate sections of the standard).

USOSHA asbestos standard for construction (29 CFR 1926.1101) regulates workplace exposure to asbestos regardless of concentration, this includes materials identified as trace. The disturbance of materials containing asbestos has the potential to result in the release of airborne asbestos fibers. The USOSHA standard requires that employee exposure to airborne asbestos fibers be maintained below 0.1 asbestos fibers per cubic centimeter of air (0.1 f/cc). Employers whose workers may be exposed to asbestos greater than the permissible exposure limits (PEL) must comply with USOSHA's Hazard Communication standard, which includes training, medical surveillance, and respiratory protection (as required by USOSHA 29 CFR 1910.134). An employer may demonstrate that employee exposure during an operation is expected to be consistently below the PEL by conducting an initial negative exposure assessment (NEA).

Disturbance or removal of materials containing asbestos must, at a minimum, follow the methods of compliance. Disturbance or removal of materials containing greater than 1% asbestos must be conducted under the appropriate class of work (Class I, Class II, or Class III work) as defined in the USOSHA standard.

Removal of ACM must be conducted by an asbestos abatement contractor with AHERA-accredited and State of South Dakota-certified asbestos abatement workers under supervision of and asbestos abatement contractor/supervisor and in accordance with applicable local, state, and federal regulations. Asbestos abatement contractors should be contacted to obtain competitive bids for removal of ACM.

A 10-working day notification is required to be submitted to the South Dakota Department of Environment and Natural Resources (DENR) prior to a renovation project where at least 260 linear feet or 160 square feet or 35 cubic feet of regulated asbestos-containing material (RACM) is to be removed or a demolition regardless if asbestos is present or not. A copy of the most current demolition notification form approved by the Department can be found at https://denr.sd.gov/des/wm/asb/asbhomepage.aspx.

Asbestos-containing waste materials must be handled and transported to a landfill permitted to accept asbestos related waste for proper disposal. Landfill should be contacted in advance to confirm acceptance and other requirements.

Should renovation work require disturbance of any building material not identified in this survey report or if additional but unsampled suspect ACMs are revealed during renovation activities, the materials must be assumed to contain asbestos and treated as such unless, prior to disturbance, sampling by an AHERA-accredited and State of South Dakota-certified asbestos inspector and analysis by an NVLAP-accredited laboratory, in accordance with local, state, and federal regulations, determines otherwise.

Identified ACM that is to remain should be maintained in an intact state to prevent the existence of asbestos hazards at the site under an Asbestos Operations and Maintenance (O & M) plan specifically prepared for the site.

## 6.2 Lead Paint

Doors, door frames, and window frames, with exception of anodized door and window frames, had mixed results from no lead detected to greater than 5 mg/cm$^2$. Based on the results of these tests, the paint on these similar components should be treated as LP.

USOSHA lead standard for construction (29 CFR 1926.62) regulates workplace exposure to lead regardless of concentration. The disturbance of paints, coatings, or materials containing lead have the potential to result in the release airborne lead dust. The USOSHA standard requires that

employee exposure to airborne lead be maintained below 50 micrograms of lead per cubic meter of air (50µg/$m^3$). Employers whose workers may be exposed to asbestos greater than the permissible exposure limits (PEL) must comply with USOSHA's Hazard Communication standard which includes training, medical surveillance, and respiratory protection (as required by USOSHA 29 CFR 1910.134). An employer may demonstrate that employee exposure during an operation is expected to be consistently below the PEL by conducting a negative initial determination for exposure.

Disturbance or removal of lead paint coating, and/or materials must, at a minimum, follow the methods of compliance requirements as defined in the USOSHA standard.

Contractors working in the area should be informed of their duties regarding potentially lead-containing paint under the OSHA Lead in Construction Standard (29 CFR 1926.62), which considers paint with lead in any concentration to be covered under this standard.

If the LP is to be disturbed or removed, lead-containing wastes must be evaluated for hazardous constituents prior to disposal. According to USEPA regulations, any waste with a Toxicity Characteristic Leaching Procedure (TCLP) concentration of lead greater than 5.0 parts per million (ppm) or milligrams per liter (mg/L) is considered hazardous. However, metal components coated with LP may be disposed as scrap metal without performing TCLP testing.

South Dakota DENR Hazardous Waste Rules regulates disposal of lead-based paint waste, as well as paint waste containing other heavy metals. South Dakota DENR can assist with questions regarding the disposal of lead-based paint wastes.

Identified LP that is to remain should be maintained in an intact state to prevent the existence of lead hazards at the site under a LP Operations and Maintenance (O & M) plan specifically prepared for the site.

## 6.3 Radon

The radon action level is based on an exposure of 18 hours per day for 40 years; however, the EPA does not have guideline action levels for commercial properties. The AARST-ANSI protocol for large buildings and schools recommends fixing the building that if radon levels are greater than half the action level, (e.g., between 2 and 4 pCi/L) and if radon levels are less than 4.0 pCi/L, the facility should be retested every 5 years and whenever significant changes occur to the building structure or mechanical systems.

Should future testing indicate concentrations that meet or exceed the action level, conduct evaluations, corrections and further testing until radon concentrations have been mitigated to below the action level."

# 7.0 LIMITATIONS/GENERAL COMMENTS

The Regulated Building Materials Survey was limited to the project areas identified by Jacobs Engineering and did not include destructive investigation to inspect wall cavities or other concealed areas and the roof. Should renovation work require disturbance of any building material not identified in this survey report, an asbestos inspection must be conducted by AHERA-accredited, State of South Dakota-certified asbestos inspector in accordance with local, state, and federal regulations prior to disturbance. If additional but unsampled suspect ACMs are revealed during renovation activities, the material(s) must be assumed to contain asbestos and treated as such unless sampled by an AHERA-accredited, State of South Dakota-certified asbestos inspector and analysis by an NVLAP-accredited laboratory determines otherwise.

The Regulated Building Materials Survey was conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions in the same locale. The results, findings, conclusions, and recommendations expressed in this report are based on conditions observed during our survey of the project area. The information contained in this report is relevant to the date on which this survey was performed and should not be relied upon to represent conditions at a later date. This report has been prepared on behalf of and exclusively for use by Jacobs Engineering for specific application to their project as discussed herein. This report is not a bidding document. Contractors or consultants reviewing this report must draw their own conclusions regarding further investigation or remediation deemed necessary. Terracon does not warrant the work of regulatory agencies, laboratories, or other third parties supplying information which may have been used in the preparation of this report. No warranty, express or implied is made.

# APPENDIX A

## BUILDING B7504, PRIDE HANGAR, ELLSWORTH AFB, SOUTH DAKOTA
## IDENTIFIED ASBESTOS-CONTAINING MATERIALS BY HOMOGENEOUS AREA (HA)

The materials listed in this table have been sampled and determined to contain asbestos in concentrations greater than 1%. When disturbed, various federal, state, and local regulations may apply. See Appendix B for a summary of samples collected and laboratory report.

| HA No. | Mat'l Code | Material Description | Material Location | % and Type Asbestos[1] | NESHAP Classification | USOSHA Classification | Estimated Quantity[2] |
|---|---|---|---|---|---|---|---|
| 02 | WB1 | White Taping Mud associated w/ Painted 5/8" White Drywall | Room 129, North Wall over Door | 2% Chrysotile | Category II | Miscellaneous | 8 SF |
| 05 | FT1 | 9 x 9 Green Vinyl Floor Tile w/ Black and Cream Streaks* | Room 101 | 10% Chrysotile | Category I | Miscellaneous | 16 SF |

[1] % & Type Asbestos = this column contains both the analytical result of the sample with the highest concentration of asbestos detected in the samples that make up the HA and the types of asbestos identified.
[2] Estimated quantities are based on a cursory field evaluation of the project area, and actual quantities may vary significantly, especially if asbestos containing materials are present in hidden and/or inaccessible areas not evaluated as part of this survey. SF = square feet; EA = each (number of pipe fittings counted).

## ASSUMED ASBESTOS-CONTAINING MATERIALS BY HOMOGENEOUS AREA (HA)

The materials listed in this table have been assumed to contain asbestos in concentrations greater than 1%. These materials must be assumed to contain asbestos and treated as such unless sampled by a State of South Dakota-certified asbestos inspector and laboratory analysis determines otherwise. When disturbed, various federal, state, and local regulations may apply.

| HA No. | Mat'l Code | Material Description | Material Location | NESHAP Classification | USOSHA Classification | Estimated Quantity |
|---|---|---|---|---|---|---|
| 29 | WP6 | Black Woven Electrical Wiring | Room 112 (on ground and assumed in some electrical fuse boxes and associated conduit) | Category II | Miscellaneous | 60+ SF |
| 30 | FD1 | Metal Fire Door | Rooms 100, 100A, 101B, 102, 108, 111, 112, 117, 120, 121, 125, 132, and 133 | Category II | Miscellaneous | 25 EA |
| 31 | FD1 | Metal Fire Door (Sliding Door) | Rooms 111, 113, and 127 | Category II | Miscellaneous | 3 EA |

## MATERIALS CONTAINING 1% OR LESS ASBESTOS BY HA

| HA No. | HA No. | Material Description | Material Location | % and Type Asbestos[1] | Condition | Estimated Quantity[2] |
|---|---|---|---|---|---|---|
| 28 | SC1 | Gray Window Glazing | Room 100 (windows on hangar doors) and Room 112 (windows) | <1% Chrysotile | Good | 1,100 SF |

[1] **% & Type Asbestos** = this column contains the analytical result of the sample by layer and the types of asbestos identified.
[2] **Estimated quantities** are based on a cursory field evaluation, and actual quantities may vary significantly, especially if asbestos containing materials are present in hidden and/or inaccessible areas not evaluated as part of this survey.

## APPENDIX B

### BUILDING B7504, PRIDE HANGAR, ELLSWORTH AFB, SOUTH DAKOTA
### ASBESTOS SURVEY SAMPLE LOCATION SUMMARY AND LABORATORY REPORT

| HA No. | Sample Number | Sample Location | Material Description | Layer | Lab Results % Asbestos | NESHAP Classification | USOSHA Classification | AHERA Assessment | Condition | HA Locations | Estimated Quantity[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 01-MG7-01 | Room 131, NW Corner, Floor | Cream Mastic (Carpet) | L1 - Cream Mastic | ND[2] | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | East Saddlebag Building, Room 131, Floor | 118 SF |
| | 01-MG7-02 | Room 131, Middle of Room, Floor | Cream Mastic | L1 - Cream Mastic | ND | | | | | | |
| | 01-MG7-03 | Room 131, SE Corner, Floor | Cream Mastic | L1 - Cream Mastic | ND | | | | | | |
| 02 | 02-WB1-04 | Room 129, Hallway, North Wall over Doorway, ~1' from East, ~8' Up | Painted 5/8" White Drywall & White Taping Mud | L1 - White Drywall w/ Brown Paper<br>L2 - Off-White Mud<br>L3 - Cream Tape | ND<br>2% Chrysotile<br>ND | Category II Nonfriable | Miscellaneous | N/A | Good | East Saddlebag Building, Room 129, North Wall over Doorway | 8 SF |
| | 02-WB1-05 | Room 129, Hallway, North Wall over Doorway, ~1' from East, ~8' Up | Painted 5/8" White Drywall & White Taping Mud | L1 - White Drywall w/ Brown Paper<br>L2 - Off-White Mud<br>L3 - Cream Tape | ND<br>2% Chrysotile<br>ND | | | | | | |
| | 02-WB1-06 | Room 129, Hallway, North Wall over Doorway, ~1' from East, ~8' Up | Painted 5/8" White Drywall & White Taping Mud | L1 - White Drywall w/ Brown Paper<br>L2 - Off-White Mud<br>L3 - Cream Tape | ND<br>2% Chrysotile<br>ND | | | | | | |
| 03 | 03-MG8-07 | Room 131, West Wall at North Side of Door, ~5' Up | Marigold Mastic | L1 - Gold Mastic | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | East Saddlebag Building, Room 131 on West Wall and Room 132 at end of Dividing Walls | 9 SF |
| | 03-MG8-08 | Room 132, East Wall (End of Dividing Wall), ~25' from South, ~15' from West, ~2' Up | Marigold Mastic | L1 - Gold Mastic | ND | | | | | | |
| | 03-MG8-09 | Room 132, East Wall (End of Dividing Wall), ~50' from South, ~15' from West, ~5' Up | Marigold Mastic | L1 - Gold Mastic | ND | | | | | | |
| 04 | 04-MG8-10 | Room 132, East Wall around Door, South Side of Door, ~3' Up | Cream Mastic | L1 - Cream Mastic | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | East Saddlebag Building, Room 132, East Wall around North Door | 10 SF |
| | 04-MG8-11 | Room 132, East Wall around Door, South Side of Door, ~5' Up | Cream Mastic | L1 - Cream Mastic | ND | | | | | | |
| | 04-MG8-12 | Room 132, East Wall around Door, North Side of Door, ~4' Up | Cream Mastic | L1 - Cream Mastic | ND | | | | | | |
| 05 | 05-FT1-13 | Room 101, ~5.5' from North, ~6" from West, Floor | 9 x 9 Green VFT w/ Cream Streaks and Cream Mastic | L1 - Green Floor Tile<br>L2 - Yellow Mastic | **10% Chrysotile**<br>ND | Category I Nonfriable | Miscellaneous | N/A | Good | West Saddlebag Building, Room 101, Floor | 16 SF |
| | 05-FT1-14 | Room 101, ~2.5' from North, ~1.5' from West, Floor | 9 x 9 Green VFT w/ Cream Streaks and Cream Mastic | L1 - Green Floor Tile<br>L2 - Yellow Mastic | **10% Chrysotile**<br>ND | | | | | | |
| | 05-FT1-15 | Room 101, ~7.5' from North, ~1' from West, Floor | 9 x 9 Green VFT w/ Cream Streaks and Cream Mastic | L1 - Green Floor Tile<br>L2 - Yellow Mastic | **10% Chrysotile**<br>ND | | | | | | |
| 06 | 06-FT2-16 | Room 101, ~7.5' from North, ~1' from West, Floor | 12 X 12 Brown Parquet Pattern VFT and Cream Mastic | L1 - Brown Floor Tile<br>L2 - Yellow Mastic | ND<br>ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | West Saddlebag Building, Room 101, Floor | 8 SF |

[1] Estimated quantities are based on a cursory field evaluation of the project area, and actual quantities may vary significantly, especially if asbestos-containing materials are present in hidden and/or inaccessible areas not evaluated as part of this survey. ~ = approximately; SF = square feet; LF = linear feet; EA = each (number of pipe fittings counted).
[2] ND = None Detect



APPENDIX B - FOR INFORMATION ONLY

| HA No. | Sample Number | Sample Location | Material Description | Layer | Lab Results % Asbestos | NESHAP Classification | USOSHA Classification | AHERA Assessment | Condition | HA Locations | Estimated Quantity[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 06-FT2-17 | Room 101, along West Wall, ~9.5' from North, Floor | 12 X 12 Brown Parquet Pattern VFT and Cream Mastic | L1 - Brown Floor Tile<br>L2 - Yellow Mastic | ND<br>ND | | | | | | |
| | 06-FT2-18 | Room 101, ~10' from North, ~9.5' from West, Floor | 12 X 12 Brown Parquet Pattern VFT and Cream Mastic | L1 - Brown Floor Tile<br>L2 - Yellow Mastic | ND<br>ND | | | | | | |
| 07 | 07-WB1-19 | Room 101, South Wall, ~25' from West, ~5' Up | Painted 5/8-inch White Drywall & White Taping Mud | L1 - White Drywall w/ Brown Paper<br>L2 - Off-White Mud w/ Paint | ND<br>ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | West Saddlebag Building, Rooms 101, 102, 103, 104, 105, 106, 107, 108, 109, 109A, Walls | 4.900 SF |
| | 07-WB1-20 | Room 105, along South Wall, ~14' from East, Base of Wall | Painted 5/8" White Drywall & White Taping Mud | L1 - White Drywall w/ Brown Paper<br>L2 - Off-White Mud w/ Paint | ND<br>ND | | | | | | |
| | 07-WB1-21 | Hallway 108, North Wall, ~7' from West, ~9.5' Up | Painted 5/8" White Drywall & White Taping Mud | L1 - White Drywall w/ Brown Paper<br>L2 - Off-White Mud w/ Paint<br>L3 - Cream Tape<br>L4 - White Compound w/ Paint | ND<br>ND<br>ND<br>ND | | | | | | |
| 08 | 08-PL5-22 | Room 101, South Wall, ~4' from East, ~5' Up | Painted White Knockdown Texture | L1 - White Texture w/ Paint | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | West Saddlebag Building, Rooms 100 (outside Rooms 101A and 101B) and 101, Walls | 133 SF |
| | 08-PL5-23 | Room 100 opposite Room 101B, West Wall, ~14' from South, ~3' Up | Painted White Knockdown Texture | L1 - White Texture w/ Paint | ND | | | | | | |
| | 08-PL5-24 | Room 100 opposite Room 101A, West Wall, ~25' from South, ~5' Up | Painted White Knockdown Texture | L1 - White Texture w/ Paint | ND | | | | | | |
| 09 | 09-SC7-25 | Room 101, Pipe by South Wall opposite Room 101A, ~6' Up | White Pipe Sealant (Pookie) | L1 - Yellow Insulation<br>L2 - White Sealant | ND<br>ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 101, on Pipe Insulation | 1 SF |
| | 09-SC7-26 | Room 101, Pipe by South Wall opposite Room 101A, ~1' Up | White Pipe Sealant (Pookie) | L1 - Yellow Insulation<br>L2 - White Sealant | ND<br>ND | | | | | | |
| | 09-SC7-27 | Room 101, Pipe by South Wall opposite Room 101A, ~6' Up | White Pipe Sealant (Pookie) | L1 - Yellow Insulation<br>L2 - White Sealant | ND<br>ND | | | | | | |
| 10 | 10-FC3-28 | Room 104, North Wall, ~4' from East, Base of Wall | Yellow Mastic associated with 4" Gray Cove Base | L1 - Yellow Mastic | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Rooms 102, 103, 104, and 105, Base of Walls | 115 SF |
| | 10-FC3-29 | Room 105, South Wall, ~14' from East, Base of Wall | Yellow Mastic associated with 4" Gray Cove Base | L1 - Yellow Mastic | ND | | | | | | |
| | 10-FC3-30 | Room 105, North Wall, ~7' from East, Base of Wall | Yellow Mastic associated with 4" Gray Cove Base | L1 - Yellow Mastic | ND | | | | | | |
| 11 | 11-CT3-31 | Room 104, ~7' from North, ~4' from East, ~8' Up | 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge | L1 - Beige Ceiling Tile w/ White Surface | ND | Friable Non-ACM | Miscellaneous | Non-ACM | Good | Rooms 102, 103, 104, and 105, Ceiling | 1,472 SF |
| | 11-CT3-32 | Room 105, along South Wall, ~17' from East, ~8' Up | 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge | L1 - Beige Ceiling Tile w/ White Surface | ND | | | | | | |
| | 11-CT3-33 | Room 105, ~5' from North, ~4' from East, ~8' Up | 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge | L1 - Beige Ceiling Tile w/ White Surface | ND | | | | | | |
| 12 | 12-CT3-34 | Room 106, ~6" from North, ~4' from West, ~8' Up | 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes | L1 - Beige Ceiling Tile w/ White Surface | ND | Friable Non-ACM | Miscellaneous | Non-ACM | Good | Rooms 106, 107, 108, 109, and 109A, Ceiling | 552 SF |
| | 12-CT3-35 | Hallway 108, along North Wall, ~7' from West, ~8' Up | 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes | L1 - Beige Ceiling Tile w/ White Surface | ND | | | | | | |
| | 12-CT3-36 | Room 109, ~1 from South, ~14' from West, ~8' Up | 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes | L1 - Beige Ceiling Tile w/ White Surface | ND | | | | | | |
| 13 | 13-FC3-37 | Room 106, North Wall at East Side of Doorway, Base of Wall | Cream Mastic associated w/ 4" Gray Cove Base | L1 - Cream Mastic | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Rooms 106, 107, 108, 109, and 109A, Base of Walls | 77 SF |

APPENDIX B - FOR INFORMATION ONLY

| HA No. | Sample Number | Sample Location | Material Description | Layer | Lab Results % Asbestos | NESHAP Classification | USOSHA Classification | AHERA Assessment | Condition | HA Locations | Estimated Quantity[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 13-FC3-38 | Hallway 108, South Wall at West Side of Doorway to Room 107, Base of Wall | Cream Mastic associated w/ 4" Gray Cove Base | L1 - Cream Mastic | ND | | | | | | |
| | 13-FC3-39 | Hallway 109A, West Wall at North Side of Doorway to Room 109, Base of Wall | Cream Mastic associated w/ 4" Gray Cove Base | L1 - Cream Mastic | ND | | | | | | |
| 14 | 14-MG7-40 | Hallway 106, along South Wall at East Side of Doorway to Room 106, Floor | Cream Mastic associated with Gray/Brown Multicolored Carpet | L1 - Cream Mastic | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Rooms 106, 107, 108, 109, and 109A, Floor | 640 SF |
| | 14-MG7-41 | Hallway 108, West End at South Side of Doorway, Floor | Cream Mastic associated with Gray/Brown Multicolored Carpet | L1 - Cream Mastic | ND | | | | | | |
| | 14-MG7-42 | Hallway 109A, West Wall at North Side of Doorway to Room 109, Floor | Cream Mastic associated with Gray/Brown Multicolored Carpet | L1 - Cream Mastic | ND | | | | | | |
| 15 | 15-FC5-43 | Room 114, Entry, ~1.5' from North, ~1' from West, Floor | Gray Floor Leveling Compound | L1 - Gray Leveling Compound | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114 Entrance Vestibule, Floor | 19 SF |
| | 15-FC5-44 | Room 114, Entry, along South Wall, ~2' from East, Floor | Gray Floor Leveling Compound | L1 - Gray Leveling Compound | ND | | | | | | |
| | 15-FC5-45 | Room 114, Entry, ~2' from South, ~3' from East, Floor | Gray Floor Leveling Compound | L1 - Gray Leveling Compound | ND | | | | | | |
| 16 | 16-MA3-46 | Room 114, at Entrance to Room 114A, ~2' from East, Floor | Gray Mortar associated w/ 1" x 1" Multi-Shade Brown Ceramic Floor Tile | L1 - Gray Mortar | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Floor | 326 SF |
| | 16-MA3-47 | Room 114, ~4' from South, ~9.5' from West, Floor | Gray Mortar associated w/ 1" x 1" Multi-Shade Brown Ceramic Floor Tile | L1 - Gray Mortar | ND | | | | | | |
| | 16-MA3-48 | Room 114, by Entrance to Room 114B, ~1' from South, ~1' from East, Floor | Gray Mortar associated w/ 1" x 1" Multi-Shade Brown Ceramic Floor Tile | L1 - Gray Mortar | ND | | | | | | |
| 17 | 17-MA4-49 | Room 114, at Entrance to Room 114A, ~2' from East, Floor | Gray Grout associated w/ 1" x 1" Multi-Shade Brown Ceramic Floor Tile | L1 - Brown Ceramic Tile<br>L2 - Yellow Adhesive<br>L3 - Gray Grout | ND<br>ND<br>ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Floor | 33 SF |
| | 17-MA4-50 | Room 114, ~4' from South, ~9.5' from West, Floor | Gray Grout associated w/ 1" x 1" Multi-Shade Brown Ceramic Floor Tile | L1 - Brown Ceramic Tile<br>L2 - Yellow Adhesive<br>L3 - Gray Grout | ND<br>ND<br>ND | | | | | | |
| | 17-MA4-51 | Room 114, by Entrance to Room 114B, ~1' from South, ~1' from East, Floor | Gray Grout associated w/ 1" x 1" Multi-Shade Brown Ceramic Floor Tile | L1 - Brown Ceramic Tile<br>L2 - Yellow Adhesive<br>L3 - Gray Grout | ND<br>ND<br>ND | | | | | | |
| 18 | 18-MA3-52 | Room 114, Shower, ~2' from North, ~1' from East, Floor | Gray Mortar associated w/ 12 x 12 Cream Ceramic Floor Tile | L1 - Cream Ceramic Tile<br>L2 - Gray Mortar | ND<br>ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Shower, Floor | 70 SF |
| | 18-MA3-53 | Room 114, Shower, ~2' from North, ~1' from East, Floor | Gray Mortar associated w/ 12" x 12" Cream Ceramic Floor Tile | L1 - Cream Ceramic Tile<br>L2 - Gray Mortar | ND<br>ND | | | | | | |
| | 18-MA3-54 | Room 114, Shower, ~2' from North, ~1' from East, Floor | Gray Mortar associated w/ 12" x 12" Cream Ceramic Floor Tile | L1 - Cream Ceramic Tile<br>L2 - Gray Mortar | ND<br>ND | | | | | | |
| 19 | 19-MA4-55 | Room 114, Shower, ~2' from North, ~1' from East, Floor | Gray Grout associated w/ 12 x 12 Cream Ceramic Floor Tile | L1 - Gray Grout | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Shower, Floor | 7 SF |
| | 19-MA4-56 | Room 114, Shower, ~2' from North, ~1' from East, Floor | Gray Grout associated w/ 12" x 12" Cream Ceramic Floor Tile | L1 - Gray Grout | ND | | | | | | |
| | 19-MA4-57 | Room 114, Shower, ~2' from North, ~1' from East, Floor | Gray Grout associated w/ 12" x 12" Cream Ceramic Floor Tile | L1 - Gray Grout | ND | | | | | | |
| 20 | 20-WB1-58 | Room 114, South Wall, ~12.5 from West, ~4.5' Up | Painted 5/8-inch White Drywall & White Taping Mud | L1 - White Drywall w/ Brown Paper<br>L2 - Off-White Mud w/ Paint<br>L3 - Cream Tape<br>L4 - White Compound w/ Paint | ND<br>ND<br>ND<br>ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Rooms 114 and 114B, Walls | 1,350 SF |

APPENDIX B - FOR INFORMATION ONLY

| HA No. | Sample Number | Sample Location | Material Description | Layer | Lab Results % Asbestos | NESHAP Classification | USOSHA Classification | AHERA Assessment | Condition | HA Locations | Estimated Quantity[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 20-WB1-59 | Room 114, Entry, SE Corner Wall, ~3' Up | Painted 5/8" White Drywall & White Taping Mud | L1 - White Drywall w/ Brown Paper<br>L2 - Off-White Mud w/ Paint<br>L3 - Cream Tape | ND<br>ND<br>ND | | | | | | |
| | 20-WB1-60 | Room 114B, SE Corner Wall, ~4' Up | Painted 5/8" White Drywall & White Taping Mud | L1 - White Drywall w/ Brown Paper<br>L2 - Off-White Mud w/ Paint<br>L3 - Cream Tape<br>L4 - White Compound w/ Paint | ND<br>ND<br>ND<br>ND | | | | | | |
| 21 | 21-MA3-61 | Room 114, NE Corner Wall, ~4' Up | Yellow Mastic associated w/ 4 x 4 Cream Ceramic Wall Tile | L1 - Yellow Mastic | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Lower half of Walls | 1,185 SF |
| | 21-MA3-62 | Room 114, North Wall (between hand wash and shower), ~5' from East, ~4' Up | Yellow Mastic associated w/ 4" x 4" Cream Ceramic Wall Tile | L1 - Yellow Mastic | ND | | | | | | |
| | 21-MA3-63 | Room 114, South Wall, ~11.5' from East, ~4' Up | Yellow Mastic associated w/ 4" x 4" Cream Ceramic Wall Tile | L1 - Yellow Mastic | ND | | | | | | |
| 22 | 22-MA4-64 | Room 114, South Wall, ~11.5' from East, ~4' Up | White Grout associated w/ 4 x 4 Cream Ceramic Wall Tile | L1 - White Grout | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Lower half of Walls | 1,280 SF |
| | 22-MA4-65 | Room 114, North Wall (between hand wash and shower), ~5' from East, ~4' Up | White Grout associated w/ 4" x 4" Cream Ceramic Wall Tile | L1 - White Grout | ND | | | | | | |
| | 22-MA4-66 | Room 114, NE Corner Wall, ~4' Up | White Grout associated w/ 4" x 4" Cream Ceramic Wall Tile | L1 - White Grout | ND | | | | | | |
| 23 | 23-MA3-67 | Room 114, Shower, East Wall at South Edge, 5.5' from North, ~5' Up | Yellow Mastic associated w/ 6 x 6 Cream Ceramic Wall Tile | L1 - Yellow Mastic | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Shower, Walls | 104 SF |
| | 23-MA3-68 | Room 114, Shower, West Wall at South Edge, 5.5' from North, ~2.5' Up | Yellow Mastic associated w/ 6" x 6" Cream Ceramic Wall Tile | L1 - Cream Ceramic Tile<br>L2 - Gray Mortar | ND<br>ND | | | | | | |
| | 23-MA3-69 | Room 114, Shower, North Wall, 6.5' from West, ~6' Up | Yellow Mastic associated w/ 6" x 6" Cream Ceramic Wall Tile | L1 - Yellow Mastic | ND | | | | | | |
| 24 | 24-MA4-70 | Room 114, Shower, East Wall at South Edge, 5.5' from North, ~5' Up | Gray Grout associated w/ 6" x 6" Cream Ceramic Wall Tile | L1 - Yellow Mastic | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Shower, Walls | 10 SF |
| | 24-MA4-71 | Room 114, Shower, West Wall at South Edge, 5.5' from North, ~2.5' Up | Gray Grout associated w/ 6" x 6" Cream Ceramic Wall Tile | L1 - Yellow Mastic | ND | | | | | | |
| | 24-MA4-72 | Room 114, Shower, North Wall, 6.5' from West, ~6' Up | Gray Grout associated w/ 6" x 6" Cream Ceramic Wall Tile | L1 - Cream Ceramic Tile<br>L2 - Gray Mortar | ND<br>ND | | | | | | |
| 25 | 25-CT4-73 | Room 114, 3' from South, 8' from East | 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes | L1 - Beige Ceiling Tile w/ White Surface | ND | Friable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Ceiling | 290 SF |
| | 25-CT4-74 | Room 114, 1' from South, 17' from West | 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes | L1 - Beige Ceiling Tile w/ White Surface | ND | | | | | | |
| | 25-CT4-75 | Room 114, 4' from North, 12' from West | 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes | L1 - Beige Ceiling Tile w/ White Surface | ND | | | | | | |
| 26 | 26-MS5-76 | Room 114, ~2' from South, ~13' from West, ~9' Up | White Paper, Foil, and Black Tar Pipe Insulation Wrap | L1 - Yellow Insulation<br>L2 - White Paper<br>L3 - Black Tar w/ Foil | ND<br>ND<br>ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Room 114, Insulated Pipes above Ceiling | 50 LF |
| | 26-MS5-77 | Room 114, ~2' from South, ~16' from West, ~9' Up | White Paper, Foil, and Black Tar Pipe Insulation Wrap | L1 - Yellow Insulation<br>L2 - White Paper<br>L3 - Black Tar w/ Foil | ND<br>ND<br>ND | | | | | | |

APPENDIX B - FOR INFORMATION ONLY

| HA No. | Sample Number | Sample Location | Material Description | Layer | Lab Results % Asbestos | NESHAP Classification | USOSHA Classification | AHERA Assessment | Condition | HA Locations | Estimated Quantity[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 26-MS5-78 | Room 114, ~2' from South, ~10' from West, ~9' Up | White Paper, Foil, and Black Tar Pipe Insulation Wrap | L1 - Yellow Insulation<br>L2 - White Paper<br>L3 - Black Tar w/ Foil | ND<br>ND<br>ND | | | | | | |
| 27 | 27-CA1-79 | Exterior, Window opposite Room 131, South Side of Window, by Column Line 60 | White Window Caulk | L1 - White Caulk | ND | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Rooms 129, 130, 131, and 132, Windows | 7 SF |
| | 27-CA1-80 | Exterior, Window opposite Room 132, South Side of Window, by Column Line 40 | White Window Caulk | L1 - White Caulk | ND | | | | | | |
| | 27-CA1-81 | Exterior, Window opposite Room 132, North Side of Window, by Column Line 30 | White Window Caulk | L1 - White Caulk | ND | | | | | | |
| 28 | 28-SC1-82 | Room 112, South Side, West Window | Gray Window Glazing | L1 - Gray Window Glazing | **<1% Chrysotile** | Nonfriable Non-ACM | Miscellaneous | Non-ACM | Good | Rooms 100 (Hangar Doors) and 112, Windows | 1,100 SF |
| | 28-SC1-83 | Room 112, South Side, East Window | Gray Window Glazing | L1 - Gray Window Glazing | ND | | | | | | |
| | 28-SC1-84 | Room 100, Hanger Door, South Side, First Door Panel from West | Gray Window Glazing | L1 - Gray Window Glazing | ND | | | | | | |

APPENDIX B - FOR INFORMATION ONLY

Report for:

**Brian Ramsell**
**Terracon Consultants, Inc. - WY**
1505 Old Happy Jack Road
Cheyenne, WY 82001

Regarding: Project: Ellsworth AFB Pride Hangar; Asbestos Survey
EML ID: 2726764

Approved by:

Approved Signatory
Amber Rutter

Dates of Analysis:
Asbestos PLM: 09-10-2021

Service SOPs: Asbestos PLM (EPA 40CFR App E to Sub E of Part 763 & EPA METHOD 600/R-93-116, SOP EM-AS-S-1267)
NVLAP Lab Code 500053-0

All samples were received in acceptable condition unless noted in the Report Comments portion in the body of the report. The results relate only to the samples as received and tested. The results include an inherent uncertainty of measurement associated with estimating percentages by polarized light microscopy. Measurement uncertainty data for sample results with >1% asbestos concentration can be provided when requested.

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(800) 651-4802 Fax (623) 780-7695 www.emlab.com

Client: Terracon Consultants, Inc. - WY
C/O: Brian Ramsell
Re: Ellsworth AFB Pride Hangar; Asbestos Survey

Date of Sampling: 09-01-2021
Date of Receipt: 09-07-2021
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## ASBESTOS PLM REPORT

| | |
|---|---|
| **Total Samples Submitted:** | 84 |
| **Total Samples Analyzed:** | 84 |
| **Total Samples with Layer Asbestos Content > 1%:** | 6 |

**Location: 01-MG7-01, Cream Mastic (Carpet)** Lab ID-Version‡: 13043958-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 01-MG7-02, Cream Mastic (Carpet)** Lab ID-Version‡: 13043959-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 01-MG7-03, Cream Mastic (Carpet)** Lab ID-Version‡: 13043960-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 02-WB1-04, Painted 5/8-Inch White Drywall & White Taping Mud** Lab ID-Version‡: 13043961-1

| Sample Layers | Asbestos Content |
|---|---|
| White Drywall with Brown Paper | ND |
| Off-White Mud | 2% Chrysotile |
| Cream Tape with Paint | ND |
| **Composite Non-Asbestos Content:** | 15% Cellulose |
| **Sample Composite Homogeneity:** | Poor |

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## ASBESTOS PLM REPORT

**Location: 02-WB1-05, Painted 5/8-Inch White Drywall & White Taping Mud** Lab ID-Version‡: 13043962-1

| Sample Layers | Asbestos Content |
|---|---|
| White Drywall with Brown Paper | ND |
| Off-White Mud | 2% Chrysotile |
| Cream Tape with Paint | ND |
| **Composite Non-Asbestos Content:** | 15% Cellulose |
| **Sample Composite Homogeneity:** | Poor |

**Location: 02-WB1-06, Painted 5/8-Inch White Drywall & White Taping Mud** Lab ID-Version‡: 13043963-1

| Sample Layers | Asbestos Content |
|---|---|
| White Drywall with Brown Paper | ND |
| Off-White Mud | 2% Chrysotile |
| Cream Tape with Paint | ND |
| **Composite Non-Asbestos Content:** | 15% Cellulose |
| **Sample Composite Homogeneity:** | Poor |

**Location: 03-MG8-07, Marigold Mastic (Paneling)** Lab ID-Version‡: 13043964-1

| Sample Layers | Asbestos Content |
|---|---|
| Gold Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 03-MG8-08, Marigold Mastic (Paneling)** Lab ID-Version‡: 13043965-1

| Sample Layers | Asbestos Content |
|---|---|
| Gold Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 03-MG8-09, Marigold Mastic (Paneling)** Lab ID-Version‡: 13043966-1

| Sample Layers | Asbestos Content |
|---|---|
| Gold Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 04-MG8-10, Cream Mastic (Paneling)** Lab ID-Version‡: 13043967-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 04-MG8-11, Cream Mastic (Paneling)** Lab ID-Version‡: 13043968-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 04-MG8-12, Cream Mastic (Paneling)** Lab ID-Version‡: 13043969-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 05-FT1-13, 9 x 9 Green VFT w/ Cream Streaks and Cream Mastic** Lab ID-Version‡: 13043970-1

| Sample Layers | Asbestos Content |
|---|---|
| Green Floor Tile | 10% Chrysotile |
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 05-FT1-14, 9 x 9 Green VFT w/ Cream Streaks and Cream Mastic** Lab ID-Version‡: 13043971-1

| Sample Layers | Asbestos Content |
|---|---|
| Green Floor Tile | 10% Chrysotile |
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 05-FT1-15, 9 x 9 Green VFT w/ Cream Streaks and Cream Mastic** Lab ID-Version‡: 13043972-1

| Sample Layers | Asbestos Content |
|---|---|
| Green Floor Tile | 10% Chrysotile |
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 06-FT2-16, 12 X 12 Brown Parquet Pattern VFT and Cream Mastic** Lab ID-Version‡: 13043973-1

| Sample Layers | Asbestos Content |
|---|---|
| Brown Floor Tile | ND |
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Moderate |

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## ASBESTOS PLM REPORT

**Location: 06-FT2-17, 12 X 12 Brown Parquet Pattern VFT and Cream Mastic** Lab ID-Version‡: 13043974-1

| Sample Layers | Asbestos Content |
|---|---|
| Brown Floor Tile | ND |
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 06-FT2-18, 12 X 12 Brown Parquet Pattern VFT and Cream Mastic** Lab ID-Version‡: 13043975-1

| Sample Layers | Asbestos Content |
|---|---|
| Brown Floor Tile | ND |
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 07-WB1-19, Painted 5/8-Inch White Drywall & White Taping Mud** Lab ID-Version‡: 13043976-1

| Sample Layers | Asbestos Content |
|---|---|
| White Drywall with Brown Paper | ND |
| White Mud with Paint | ND |
| **Composite Non-Asbestos Content:** | 10% Cellulose |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 07-WB1-20, Painted 5/8-Inch White Drywall & White Taping Mud** Lab ID-Version‡: 13043977-1

| Sample Layers | Asbestos Content |
|---|---|
| White Drywall with Brown Paper | ND |
| White Mud with Paint | ND |
| **Composite Non-Asbestos Content:** | 10% Cellulose |
| **Sample Composite Homogeneity:** | Moderate |

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## ASBESTOS PLM REPORT

**Location: 07-WB1-21, Painted 5/8-Inch White Drywall & White Taping Mud** Lab ID-Version‡: 13043978-1

| Sample Layers | Asbestos Content |
|---|---|
| White Drywall with Brown Paper | ND |
| White Mud | ND |
| Cream Tape | ND |
| White Compound with Paint | ND |
| **Composite Non-Asbestos Content:** | 15% Cellulose |
| **Sample Composite Homogeneity:** | Poor |

**Location: 08-PL5-22, Painted White Knockdown Texture** Lab ID-Version‡: 13043979-1

| Sample Layers | Asbestos Content |
|---|---|
| White Texture with Paint | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 08-PL5-23, Painted White Knockdown Texture** Lab ID-Version‡: 13043980-1

| Sample Layers | Asbestos Content |
|---|---|
| White Texture with Paint | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 08-PL5-24, Painted White Knockdown Texture** Lab ID-Version‡: 13043981-1

| Sample Layers | Asbestos Content |
|---|---|
| White Texture with Paint | ND |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 09-SC7-25, White Sealant (on Pipe Insulation)** Lab ID-Version‡: 13043982-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Insulation | ND |
| White Sealant | ND |
| **Composite Non-Asbestos Content:** | 60% Glass Fibers |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 09-SC7-26, White Sealant (on Pipe Insulation)** Lab ID-Version‡: 13043983-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Insulation | ND |
| White Sealant | ND |
| **Composite Non-Asbestos Content:** | 60% Glass Fibers |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 09-SC7-27, White Sealant (on Pipe Insulation)** Lab ID-Version‡: 13043984-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Insulation | ND |
| White Sealant | ND |
| **Composite Non-Asbestos Content:** | 60% Glass Fibers |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 10-FC3-28, Yellow Mastic associated With 4-Inch Gray Cove Base** Lab ID-Version‡: 13043985-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 10-FC3-29, Yellow Mastic associated With 4-Inch Gray Cove Base** Lab ID-Version‡: 13043986-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 10-FC3-30, Yellow Mastic associated With 4-Inch Gray Cove Base** Lab ID-Version‡: 13043987-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 11-CT3-31, 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge** Lab ID-Version‡: 13043988-1

| Sample Layers | Asbestos Content |
|---|---|
| Beige Ceiling Tile with White Surface | ND |
| **Composite Non-Asbestos Content:** | 40% Cellulose<br>40% Glass Fibers |
| **Sample Composite Homogeneity:** | Good |

**Location: 11-CT3-32, 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge** Lab ID-Version‡: 13043989-1

| Sample Layers | Asbestos Content |
|---|---|
| Beige Ceiling Tile with White Surface | ND |
| **Composite Non-Asbestos Content:** | 40% Cellulose<br>40% Glass Fibers |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 11-CT3-33, 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge**

Lab ID-Version‡: 13043990-1

| Sample Layers | Asbestos Content |
|---|---|
| Beige Ceiling Tile with White Surface | ND |
| **Composite Non-Asbestos Content:** | 40% Cellulose<br>40% Glass Fibers |
| **Sample Composite Homogeneity:** | Good |

**Location: 12-CT3-34, 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes**

Lab ID-Version‡: 13043991-1

| Sample Layers | Asbestos Content |
|---|---|
| Beige Ceiling Tile with White Surface | ND |
| **Composite Non-Asbestos Content:** | 40% Cellulose<br>40% Glass Fibers |
| **Sample Composite Homogeneity:** | Good |

**Location: 12-CT3-35, 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes**

Lab ID-Version‡: 13043992-1

| Sample Layers | Asbestos Content |
|---|---|
| Beige Ceiling Tile with White Surface | ND |
| **Composite Non-Asbestos Content:** | 40% Cellulose<br>40% Glass Fibers |
| **Sample Composite Homogeneity:** | Good |

**Location: 12-CT3-36, 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes**

Lab ID-Version‡: 13043993-1

| Sample Layers | Asbestos Content |
|---|---|
| Beige Ceiling Tile with White Surface | ND |
| **Composite Non-Asbestos Content:** | 40% Cellulose<br>40% Glass Fibers |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 13-FC3-37, Cream Mastic associated w/ 4-Inch Gray Cove Base** Lab ID-Version‡: 13043994-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 13-FC3-38, Cream Mastic associated w/ 4-Inch Gray Cove Base** Lab ID-Version‡: 13043995-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 13-FC3-39, Cream Mastic associated w/ 4-Inch Gray Cove Base** Lab ID-Version‡: 13043996-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 14-MG7-40, Cream Mastic associated with Gray/Brown Multicolored Carpet** Lab ID-Version‡: 13043997-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

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Re: Ellsworth AFB Pride Hangar; Asbestos Survey

Date of Sampling: 09-01-2021
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## ASBESTOS PLM REPORT

**Location: 14-MG7-41, Cream Mastic associated with Gray/Brown Multicolored Carpet** Lab ID-Version‡: 13043998-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 14-MG7-42, Cream Mastic associated with Gray/Brown Multicolored Carpet** Lab ID-Version‡: 13043999-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 15-FC5-43, Gray Floor Leveling Compound** Lab ID-Version‡: 13044000-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Leveling Compound | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 15-FC5-44, Gray Floor Leveling Compound** Lab ID-Version‡: 13044001-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Leveling Compound | ND |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 15-FC5-45, Gray Floor Leveling Compound** Lab ID-Version‡: 13044002-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Leveling Compound | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 16-MA3-46, Gray Mortar associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile** Lab ID-Version‡: 13044003-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Mortar | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 16-MA3-47, Gray Mortar associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile** Lab ID-Version‡: 13044004-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Mortar | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 16-MA3-48, Gray Mortar associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile** Lab ID-Version‡: 13044005-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Mortar | ND |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 17-MA4-49, Gray Grout associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile**

Lab ID-Version‡: 13044006-1

| Sample Layers | Asbestos Content |
|---|---|
| Brown Ceramic Tile | ND |
| Yellow Adhesive | ND |
| Gray Grout | ND |
| **Sample Composite Homogeneity:** | Poor |

**Location: 17-MA4-50, PGray Grout associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile**

Lab ID-Version‡: 13044007-1

| Sample Layers | Asbestos Content |
|---|---|
| Brown Ceramic Tile | ND |
| Yellow Adhesive | ND |
| Gray Grout | ND |
| **Sample Composite Homogeneity:** | Poor |

**Location: 17-MA4-51, Gray Grout associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile**

Lab ID-Version‡: 13044008-1

| Sample Layers | Asbestos Content |
|---|---|
| Brown Ceramic Tile | ND |
| Yellow Adhesive | ND |
| Gray Grout | ND |
| **Sample Composite Homogeneity:** | Poor |

**Location: 18-MA3-52, Gray Mortar associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile**

Lab ID-Version‡: 13044009-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Ceramic Tile | ND |
| Gray Mortar | ND |
| **Sample Composite Homogeneity:** | Moderate |

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## ASBESTOS PLM REPORT

**Location: 18-MA3-53, Gray Mortar associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile**

Lab ID-Version‡: 13044010-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Ceramic Tile | ND |
| Gray Mortar | ND |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 18-MA3-54, Gray Mortar associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile**

Lab ID-Version‡: 13044011-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Ceramic Tile | ND |
| Gray Mortar | ND |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 19-MA4-55, Gray Grout associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile**

Lab ID-Version‡: 13044012-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Grout | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 19-MA4-56, Gray Grout associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile**

Lab ID-Version‡: 13044013-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Grout | ND |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 19-MA4-57, Gray Grout associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile**

Lab ID-Version‡: 13044014-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Grout | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 20-WB1-58, Painted 5/8-Inch White Drywall & White Taping Mud**

Lab ID-Version‡: 13044015-1

| Sample Layers | Asbestos Content |
|---|---|
| White Drywall with Brown Paper | ND |
| White Mud | ND |
| Cream Tape | ND |
| White Compound with Paint | ND |
| **Composite Non-Asbestos Content:** | 15% Cellulose |
| **Sample Composite Homogeneity:** | Poor |

**Location: 20-WB1-59, Painted 5/8-Inch White Drywall & White Taping Mud**

Lab ID-Version‡: 13044016-1

| Sample Layers | Asbestos Content |
|---|---|
| White Drywall with Brown Paper | ND |
| White Mud | ND |
| Cream Tape with Paint | ND |
| **Composite Non-Asbestos Content:** | 15% Cellulose |
| **Sample Composite Homogeneity:** | Poor |

**Location: 20-WB1-60, Painted 5/8-Inch White Drywall & White Taping Mud**

Lab ID-Version‡: 13044017-1

| Sample Layers | Asbestos Content |
|---|---|
| White Drywall with Brown Paper | ND |
| White Mud | ND |
| Cream Tape | ND |
| White Compound with Paint | ND |
| **Composite Non-Asbestos Content:** | 15% Cellulose |
| **Sample Composite Homogeneity:** | Poor |

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## ASBESTOS PLM REPORT

**Location: 21-MA3-61, Yellow Mastic associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044018-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 21-MA3-62, Yellow Mastic associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044019-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 21-MA3-63, Yellow Mastic associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044020-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| White Compound | ND |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 22-MA4-64, White Grout associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044021-1

| Sample Layers | Asbestos Content |
|---|---|
| White Grout | ND |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 22-MA4-65, White Grout associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044022-1

| Sample Layers | Asbestos Content |
|---|---|
| White Grout | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 22-MA4-66, White Grout associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044023-1

| Sample Layers | Asbestos Content |
|---|---|
| White Grout | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 23-MA3-67, Yellow Mastic associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044024-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 23-MA3-68, Yellow Mastic associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044025-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Ceramic Tile | ND |
| Gray Mortar | ND |
| **Sample Composite Homogeneity:** | Moderate |

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## ASBESTOS PLM REPORT

**Location: 23-MA3-69, Yellow Mastic associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044026-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 24-MA4-70, Gray Grout associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044027-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 24-MA4-71, Gray Grout associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044028-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Mastic | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 24-MA4-72, Gray Grout associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile**

Lab ID-Version‡: 13044029-1

| Sample Layers | Asbestos Content |
|---|---|
| Cream Ceramic Tile | ND |
| Gray Mortar | ND |
| **Sample Composite Homogeneity:** | Moderate |

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## ASBESTOS PLM REPORT

**Location: 25-CT4-73, 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes** Lab ID-Version‡: 13044030-1

| Sample Layers | Asbestos Content |
|---|---|
| Beige Ceiling Tile with White Surface | ND |
| **Composite Non-Asbestos Content:** | 40% Cellulose<br>40% Glass Fibers |
| **Sample Composite Homogeneity:** | Good |

**Location: 25-CT4-74, 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes** Lab ID-Version‡: 13044031-1

| Sample Layers | Asbestos Content |
|---|---|
| Beige Ceiling Tile with White Surface | ND |
| **Composite Non-Asbestos Content:** | 40% Cellulose<br>40% Glass Fibers |
| **Sample Composite Homogeneity:** | Good |

**Location: 25-CT4-75, 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes** Lab ID-Version‡: 13044032-1

| Sample Layers | Asbestos Content |
|---|---|
| Beige Ceiling Tile with White Surface | ND |
| **Composite Non-Asbestos Content:** | 40% Cellulose<br>40% Glass Fibers |
| **Sample Composite Homogeneity:** | Good |

**Location: 26-MS5-76, White Paper, Foil, and Black Felt-backed Pipe Insulation Wrap** Lab ID-Version‡: 13044033-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Insulation | ND |
| White Paper | ND |
| Black Tar with Foil | ND |
| **Composite Non-Asbestos Content:** | 20% Glass Fibers<br>10% Cellulose |
| **Sample Composite Homogeneity:** | Moderate |

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## ASBESTOS PLM REPORT

**Location: 26-MS5-77, White Paper, Foil, and Black Felt-backed Pipe Insulation Wrap** Lab ID-Version‡: 13044034-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Insulation | ND |
| White Paper | ND |
| Black Tar with Foil | ND |
| **Composite Non-Asbestos Content:** | 20% Glass Fibers<br>10% Cellulose |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 26-MS5-78, White Paper, Foil, and Black Felt-backed Pipe Insulation Wrap** Lab ID-Version‡: 13044035-1

| Sample Layers | Asbestos Content |
|---|---|
| Yellow Insulation | ND |
| White Paper | ND |
| Black Tar with Foil | ND |
| **Composite Non-Asbestos Content:** | 20% Glass Fibers<br>10% Cellulose |
| **Sample Composite Homogeneity:** | Moderate |

**Location: 27-CA1-79, White Window Caulk** Lab ID-Version‡: 13044036-1

| Sample Layers | Asbestos Content |
|---|---|
| White Caulk | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 27-CA1-80, White Window Caulk** Lab ID-Version‡: 13044037-1

| Sample Layers | Asbestos Content |
|---|---|
| White Caulk | ND |
| **Sample Composite Homogeneity:** | Good |

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## ASBESTOS PLM REPORT

**Location: 27-CA1-81, White Window Caulk** Lab ID-Version‡: 13044038-1

| Sample Layers | Asbestos Content |
|---|---|
| White Caulk | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 28-SC1-82, Gray Window Glazing** Lab ID-Version‡: 13044039-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Window Glazing | < 1% Chrysotile |
| **Sample Composite Homogeneity:** | Good |

**Location: 28-SC1-83, Gray Window Glazing** Lab ID-Version‡: 13044040-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Window Glazing | ND |
| **Sample Composite Homogeneity:** | Good |

**Location: 28-SC1-84, Gray Window Glazing** Lab ID-Version‡: 13044041-1

| Sample Layers | Asbestos Content |
|---|---|
| Gray Window Glazing | ND |
| **Sample Composite Homogeneity:** | Good |

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| Weather | | Fog | Rain | Snow | Wind | Clear |
|---|---|---|---|---|---|---|
| Level | None | ☒ | ☒ | ☒ | ☐ | ☐ |
| | Light | ☐ | ☐ | ☐ | ☐ | |
| | Moderate | ☐ | ☐ | ☐ | ☒ | |
| | Heavy | ☐ | ☐ | ☐ | ☐ | |

| EMLab ID |
|---|
| 2726764 |

## CONTACT INFORMATION

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| Contact: | Brian Ramsell | Special Instructions: | |
| Phone: | (307) 632-9224 | | |

## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project ID: | Ellsworth AFB Pride Hangar | | |
| Project Description: | Asbestos Survey | | |
| Project Zip Code: | 57706 | Sampling Date & Time: | 09/01/2021 08:00 AM |
| PO Number: | 24217029 | Sampled By: | Brian Ramsell |

## TURN AROUND TIME CODES (TAT)

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## REQUESTED SERVICES

(Use checkboxes below)

| Sample ID | Description | Sample Type (Below) | TAT (Above) | Volume / Area (as applicable) | ISO Class (as applicable) | Notes (Time of day, Temp, RH, etc.) | Asbestos PLM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01-MG7-01 | Cream Mastic (Carpet) | B | STD | N/A | | Room 131 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 01-MG7-02 | Cream Mastic (Carpet) | B | STD | N/A | | Room 131 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 01-MG7-03 | Cream Mastic (Carpet) | B | STD | N/A | | Room 131 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 02-WB1-04 | Painted 5/8-Inch White Drywall & White Taping Mud | B | STD | N/A | | Room 129 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 02-WB1-05 | Painted 5/8-Inch White Drywall & White Taping Mud | B | STD | N/A | | Room 129 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 02-WB1-06 | Painted 5/8-Inch White Drywall & White Taping Mud | B | STD | N/A | | Room 129 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 03-MG8-07 | Marigold Mastic (Paneling) | B | STD | N/A | | Rooms 131 & 132 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 03-MG8-08 | Marigold Mastic (Paneling) | B | STD | N/A | | Rooms 131 & 132 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 03-MG8-09 | Marigold Mastic (Paneling) | B | STD | N/A | | Rooms 131 & 132 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 04-MG8-10 | Cream Mastic (Paneling) | B | STD | N/A | | Room 132 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 04-MG8-11 | Cream Mastic (Paneling) | B | STD | N/A | | Room 132 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |

| SAMPLE TYPE CODES | | RELINQUISHED BY | DATE & TIME | RECEIVED BY | DATE & TIME |
|---|---|---|---|---|---|
| B - Bulk sample | | Mike Fera | 9/7/2021 8:00 AM | | |
| | | | | | |
| | | | | | |

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Phoenix, AZ: 1501 West Knudsen Drive, Phoenix, AZ 85027 * (800) 651-4802
SSF, CA: 6000 Shoreline Court, Suite 205, South San Francisco, CA 94080 * (866) 888-6653

| Weather | | Fog | Rain | Snow | Wind | Clear |
|---|---|---|---|---|---|---|
| Level | None | ☒ | ☒ | ☒ | ☐ | ☐ |
| | Light | ☐ | ☐ | ☐ | ☐ | |
| | Moderate | ☐ | ☐ | ☐ | ☒ | |
| | Heavy | ☐ | ☐ | ☐ | ☐ | |

| EMLab ID |
|---|
| 2726764 |

## CONTACT INFORMATION

| | | | |
|---|---|---|---|
| Company: | Terracon Consultants, Inc. - WY (38730) | Address: | 1505 Old Happy Jack Road Cheyenne, WY 82001 |
| Contact: | Brian Ramsell | Special Instructions: | |
| Phone: | (307) 632-9224 | | |

## PROJECT INFORMATION

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|---|---|---|---|
| Project ID: | Ellsworth AFB Pride Hangar | | |
| Project Description: | Asbestos Survey | | |
| Project Zip Code: | 57706 | Sampling Date & Time: | 09/01/2021 08:00 AM |
| PO Number: | 24217029 | Sampled By: | Brian Ramsell |

## TURN AROUND TIME CODES (TAT)

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 04-MG8-12 | Cream Mastic (Paneling) | B | STD | N/A | | Room 132 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 05-FT1-13 | 9 x 9 Green VFT w/ Cream Streaks and Cream Mastic | B | STD | N/A | | Room 101 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 05-FT1-14 | 9 x 9 Green VFT w/ Cream Streaks and Cream Mastic | B | STD | N/A | | Room 101 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 05-FT1-15 | 9 x 9 Green VFT w/ Cream Streaks and Cream Mastic | B | STD | N/A | | Room 101 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 06-FT2-16 | 12 X 12 Brown Parquet Pattern VFT and Cream Mastic | B | STD | N/A | | Room 101 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 06-FT2-17 | 12 X 12 Brown Parquet Pattern VFT and Cream Mastic | B | STD | N/A | | Room 101 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 06-FT2-18 | 12 X 12 Brown Parquet Pattern VFT and Cream Mastic | B | STD | N/A | | Room 101 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 07-WB1-19 | Painted 5/8-Inch White Drywall & White Taping Mud | B | STD | N/A | | Rooms 100, 101, 101A 101B and Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 07-WB1-20 | Painted 5/8-Inch White Drywall & White Taping Mud | B | STD | N/A | | Rooms 100, 101, 101A 101B and Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 07-WB1-21 | Painted 5/8-Inch White Drywall & White Taping Mud | B | STD | N/A | | Rooms 100, 101, 101A 101B and Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 08-PL5-22 | Painted White Knockdown Texture | B | STD | N/A | | Rooms 100, 101, 101A and 101B | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |

| SAMPLE TYPE CODES | | RELINQUISHED BY | DATE & TIME | RECEIVED BY | DATE & TIME |
|---|---|---|---|---|---|
| B - Bulk sample | | Mike Fera | 9/7/2021 8:00 AM | | |
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SSF, CA: 6000 Shoreline Court, Suite 205, South San Francisco, CA 94080 * (866) 888-6653

| Weather | | Fog | Rain | Snow | Wind | Clear |
|---|---|---|---|---|---|---|
| Level | None | ☒ | ☒ | ☒ | ☐ | ☐ |
| | Light | ☐ | ☐ | ☐ | ☐ | |
| | Moderate | ☐ | ☐ | ☐ | ☒ | |
| | Heavy | ☐ | ☐ | ☐ | ☐ | |

| EMLab ID |
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| 2726764 |

## CONTACT INFORMATION

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| Contact: | Brian Ramsell | Special Instructions: | |
| Phone: | (307) 632-9224 | | |

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| Project ID: | Ellsworth AFB Pride Hangar | | |
| Project Description: | Asbestos Survey | | |
| Project Zip Code: | 57706 | Sampling Date & Time: | 09/01/2021 08:00 AM |
| PO Number: | 24217029 | Sampled By: | Brian Ramsell |

## TURN AROUND TIME CODES (TAT)

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08-PL5-23 | Painted White Knockdown Texture | B | STD | N/A | | Rooms 100, 101, 101A and 101B | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 08-PL5-24 | Painted White Knockdown Texture | B | STD | N/A | | Rooms 100, 101, 101A and 101B | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 09-SC7-25 | White Sealant (on Pipe Insulation) | B | STD | N/A | | Room 101 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 09-SC7-26 | White Sealant (on Pipe Insulation) | B | STD | N/A | | Room 101 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 09-SC7-27 | White Sealant (on Pipe Insulation) | B | STD | N/A | | Room 101 | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10-FC3-28 | Yellow Mastic associated With 4-Inch Gray Cove Base | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10-FC3-29 | Yellow Mastic associated With 4-Inch Gray Cove Base | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10-FC3-30 | Yellow Mastic associated With 4-Inch Gray Cove Base | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11-CT3-31 | 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11-CT3-32 | 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11-CT3-33 | 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |

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|---|---|---|---|---|---|
| B - Bulk sample | | Mike Fera | 9/7/2021 8:00 AM | | |
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SSF, CA: 6000 Shoreline Court, Suite 205, South San Francisco, CA 94080 * (866) 888-6653

| Weather | | Fog | Rain | Snow | Wind | Clear |
|---|---|---|---|---|---|---|
| Level | None | ☒ | ☒ | ☒ | ☐ | ☐ |
| | Light | ☐ | ☐ | ☐ | ☐ | |
| | Moderate | ☐ | ☐ | ☐ | ☒ | |
| | Heavy | ☐ | ☐ | ☐ | ☐ | |

**EMLab ID**: 2726764

## CONTACT INFORMATION

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| Contact: | Brian Ramsell | Special Instructions: | |
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## PROJECT INFORMATION

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| Project Zip Code: | 57706 | Sampling Date & Time: | 09/01/2021 08:00 AM |
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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12-CT3-34 | 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12-CT3-35 | 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12-CT3-36 | 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13-FC3-37 | Cream Mastic associated w/ 4-Inch Gray Cove Base | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13-FC3-38 | Cream Mastic associated w/ 4-Inch Gray Cove Base | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13-FC3-39 | Cream Mastic associated w/ 4-Inch Gray Cove Base | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14-MG7-40 | Cream Mastic associated with Gray/Brown Multicolored Carpet | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14-MG7-41 | Cream Mastic associated with Gray/Brown Multicolored Carpet | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14-MG7-42 | Cream Mastic associated with Gray/Brown Multicolored Carpet | B | STD | N/A | | Honor Guard Offices | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 15-FC5-43 | Gray Floor Leveling Compound | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 15-FC5-44 | Gray Floor Leveling Compound | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |

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| Weather | | Fog | Rain | Snow | Wind | Clear |
|---|---|---|---|---|---|---|
| Level | None | ☒ | ☒ | ☒ | ☐ | ☐ |
| | Light | ☐ | ☐ | ☐ | ☐ | |
| | Moderate | ☐ | ☐ | ☐ | ☒ | |
| | Heavy | ☐ | ☐ | ☐ | ☐ | |

**EMLab ID**: 2726764

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15-FC5-45 | Gray Floor Leveling Compound | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 16-MA3-46 | Gray Mortar associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 16-MA3-47 | Gray Mortar associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 16-MA3-48 | Gray Mortar associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 17-MA4-49 | Gray Grout associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 17-MA4-50 | PGray Grout associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 17-MA4-51 | Gray Grout associated w/ 1-Inch x 1-Inch Multi-Shade Brown Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18-MA3-52 | Gray Mortar associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18-MA3-53 | Gray Mortar associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 18-MA3-54 | Gray Mortar associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19-MA4-55 | Gray Grout associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |

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|---|---|---|---|---|---|
| B - Bulk sample | | Mike Fera | 9/7/2021 8:00 AM | | |
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| Weather | | Fog | Rain | Snow | Wind | Clear |
|---|---|---|---|---|---|---|
| Level | None | ☒ | ☒ | ☒ | ☐ | ☐ |
| | Light | ☐ | ☐ | ☐ | ☐ | |
| | Moderate | ☐ | ☐ | ☐ | ☒ | |
| | Heavy | ☐ | ☐ | ☐ | ☐ | |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 19-MA4-56 | Gray Grout associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19-MA4-57 | Gray Grout associated w/ 12-Inch x 12-Inch Cream Ceramic Floor Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20-WB1-58 | Painted 5/8-Inch White Drywall & White Taping Mud | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20-WB1-59 | Painted 5/8-Inch White Drywall & White Taping Mud | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20-WB1-60 | Painted 5/8-Inch White Drywall & White Taping Mud | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21-MA3-61 | Yellow Mastic associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21-MA3-62 | Yellow Mastic associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21-MA3-63 | Yellow Mastic associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22-MA4-64 | White Grout associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22-MA4-65 | White Grout associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22-MA4-66 | White Grout associated w/ 4-Inch x 4-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |

| SAMPLE TYPE CODES | | RELINQUISHED BY | DATE & TIME | RECEIVED BY | DATE & TIME |
|---|---|---|---|---|---|
| B - Bulk sample | | Mike Fera | 9/7/2021 8:00 AM | | |
| | | | | | |
| | | | | | |

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# CHAIN OF CUSTODY

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SSF, CA: 6000 Shoreline Court, Suite 205, South San Francisco, CA 94080 * (866) 888-6653

| Weather | | Fog | Rain | Snow | Wind | Clear |
|---|---|---|---|---|---|---|
| Level | None | ☒ | ☒ | ☒ | ☐ | ☐ |
| | Light | ☐ | ☐ | ☐ | ☐ | |
| | Moderate | ☐ | ☐ | ☐ | ☒ | |
| | Heavy | ☐ | ☐ | ☐ | ☐ | |

**EMLab ID**: 2726764

## CONTACT INFORMATION

| | | | |
|---|---|---|---|
| Company: | Terracon Consultants, Inc. - WY (38730) | Address: | 1505 Old Happy Jack Road Cheyenne, WY 82001 |
| Contact: | Brian Ramsell | Special Instructions: | |
| Phone: | (307) 632-9224 | | |

## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project ID: | Ellsworth AFB Pride Hangar | | |
| Project Description: | Asbestos Survey | | |
| Project Zip Code: | 57706 | Sampling Date & Time: | 09/01/2021 08:00 AM |
| PO Number: | 24217029 | Sampled By: | Brian Ramsell |

## TURN AROUND TIME CODES (TAT)

**STD** – Standard (DEFAULT)
**ND** – Next Business Day
**SD** – Same Business Day Rush
**WH** – Weekend / Holiday

Rushes received after 2pm or on weekends, will be considered received the next business day. Please alert us in advance of weekend analysis needs.

## REQUESTED SERVICES

(Use checkboxes below)

| Sample ID | Description | Sample Type (Below) | TAT (Above) | Volume / Area (as applicable) | ISO Class (as applicable) | Notes (Time of day, Temp, RH, etc.) | Asbestos PLM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23-MA3-67 | Yellow Mastic associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 23-MA3-68 | Yellow Mastic associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 23-MA3-69 | Yellow Mastic associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 24-MA4-70 | Gray Grout associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 24-MA4-71 | Gray Grout associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 24-MA4-72 | Gray Grout associated w/ 6-Inch x 6-Inch Cream Ceramic Wall Tile | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 25-CT4-73 | 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 25-CT4-74 | 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 25-CT4-75 | 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 26-MS5-76 | White Paper, Foil, and Black Felt-backed Pipe Insulation Wrap | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 26-MS5-77 | White Paper, Foil, and Black Felt-backed Pipe Insulation Wrap | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |

| SAMPLE TYPE CODES | | RELINQUISHED BY | DATE & TIME | RECEIVED BY | DATE & TIME |
|---|---|---|---|---|---|
| B - Bulk sample | | Mike Fera | 9/7/2021 8:00 AM | | |
| | | | | | |
| | | | | | |

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# CHAIN OF CUSTODY

**www.EMLabPK.com**

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Phoenix, AZ: 1501 West Knudsen Drive, Phoenix, AZ 85027 * (800) 651-4802
SSF, CA: 6000 Shoreline Court, Suite 205, South San Francisco, CA 94080 * (866) 888-6653

| Weather | | Fog | Rain | Snow | Wind | Clear |
|---|---|---|---|---|---|---|
| Level | None | ☒ | ☒ | ☒ | ☐ | ☐ |
| | Light | ☐ | ☐ | ☐ | ☐ | |
| | Moderate | ☐ | ☐ | ☐ | ☒ | |
| | Heavy | ☐ | ☐ | ☐ | ☐ | |

**EMLab ID**: 2726764

## CONTACT INFORMATION

| | | | |
|---|---|---|---|
| Company: | Terracon Consultants, Inc. - WY (38730) | Address: | 1505 Old Happy Jack Road Cheyenne, WY 82001 |
| Contact: | Brian Ramsell | Special Instructions: | |
| Phone: | (307) 632-9224 | | |

## PROJECT INFORMATION

| | | | |
|---|---|---|---|
| Project ID: | Ellsworth AFB Pride Hangar | | |
| Project Description: | Asbestos Survey | | |
| Project Zip Code: | 57706 | Sampling Date & Time: | 09/01/2021 08:00 AM |
| PO Number: | 24217029 | Sampled By: | Brian Ramsell |

## TURN AROUND TIME CODES (TAT)

**STD** – Standard (DEFAULT)
**ND** – Next Business Day
**SD** – Same Business Day Rush
**WH** – Weekend / Holiday

Rushes received after 2pm or on weekends, will be considered received the next business day. Please alert us in advance of weekend analysis needs.

## REQUESTED SERVICES

(Use checkboxes below)

| Sample ID | Description | Sample Type (Below) | TAT (Above) | Volume / Area (as applicable) | ISO Class (as applicable) | Notes (Time of day, Temp, RH, etc.) | Asbestos PLM | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26-MS5-78 | White Paper, Foil, and Black Felt-backed Pipe Insulation Wrap | B | STD | N/A | | Rooms 115 Restroom | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 27-CA1-79 | White Window Caulk | B | STD | N/A | | West Exterior Windows | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 27-CA1-80 | White Window Caulk | B | STD | N/A | | West Exterior Windows | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 27-CA1-81 | White Window Caulk | B | STD | N/A | | West Exterior Windows | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 28-SC1-82 | Gray Window Glazing | B | STD | N/A | | Room 100 Hangar Door Windows and Room 112 Windows | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 28-SC1-83 | Gray Window Glazing | B | STD | N/A | | Room 100 Hangar Door Windows and Room 112 Windows | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 28-SC1-84 | Gray Window Glazing | B | STD | N/A | | Room 100 Hangar Door Windows and Room 112 Windows | ☒ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | | | | | | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

| SAMPLE TYPE CODES | | RELINQUISHED BY | DATE & TIME | RECEIVED BY | DATE & TIME |
|---|---|---|---|---|---|
| B - Bulk sample | | Mike Fera | 9/7/2021 8:00 AM | | |
| | | | | | |
| | | | | | |

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**APPENDIX C**

**BUILDING B7504, PRIDE HANGAR, ELLSWORTH AFB, SOUTH DAKOTA**
**XRF INSPECTION TABLE**

| Test Number | Floor | Side | Location | Component | Substrate | Color | Condition | Lead Concentration mg/cm² | Sample Code | Sample Number |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | Calibration | | | | | Passed | | |
| 2 | | | Room 100 | Wall Frame | Metal | White | Intact | 5 | | |
| 3 | | | Room 100 | Wall Panels | Wood | White | Intact | 5 | | |
| 4 | 1 | | Room 100 | Door | Metal | Brown | Intact | ND | | |
| 5 | 1 | A | Room 100 | Wall | CMU Block | White | Intact | 0.24 | | |
| 6 | 1 | A | Room 100 | Wall | CMU Block | Brown | Intact | 0.10 | | |
| 7 | 1 | A | Room 100 | Door | Metal | Brown | Intact | ND | | |
| 8 | 1 | B | Room 100 | Door Frame | Metal | Brown | Intact | 0.57 | | |
| 9 | 1 | B | Room 100 | Door | Wood | Brown | Intact | 0.31 | | |
| 10 | 1 | B | Room 100 | Door Frame | Wood | Brown | Intact | 0.14 | | |
| 11 | 1 | B | Room 100 | Window Frame | Metal | Brown | Intact | 0.059 | | |
| 12 | 1 | B | Room 100 | Railing | Metal | Brown | Intact | 5 | | |
| 13 | 1 | B | Room 100 | Stair Stringer | Metal | Brown | Intact | 5 | | |
| 14 | 1 | B | Room 100 | Wall | Metal | White | Intact | 5 | | |
| 15 | 1 | B | Room 100 | Wall | Wood | White | Intact | 5 | | |
| 16 | 1 | B | Room 100 | Door | Metal | Brown | Intact | <0.001 | | |
| 17 | 1 | C | Room 100 | Wall | CMU Block | White | Intact | 0.03 | | |
| 18 | 1 | C | Room 100 | Wall | CMU Block | Brown | Intact | 0.11 | | |
| 19 | 1 | C | Room 100 | Wall | Gypsum Board | White | Intact | ND | | |
| 20 | 1 | D | Room 100 | Wall | Gypsum Board | Brown | Intact | ND | | |
| 21 | 1 | D | Room 100 | Door | Wood | Brown | Intact | 0.20 | | |
| 22 | 1 | D | Room 100 | Door Frame | Metal | Brown | Intact | 0.12 | | |
| 23 | 1 | D | Room 100 | Window | Metal | Light Brown | Intact | 0.05 | | |
| 24 | 1 | D | Room 100 | Railing | Metal | Brown | Intact | 0.12 | | |
| 25 | 1 | D | Room 101 | Wall | Concrete | Pink | Intact | 5.00 | | |
| 26 | 1 | B | Room 101 | Wall | Brick | White | Intact | 0.24 | | |
| 27 | 1 | C | Room 101 | Wall | Gypsum Board | White | Intact | ND | P | 01 |
| 28 | 1 | C | Room 101 | Wall | Concrete | Pink | Intact | 3.03 | | |
| 29 | 1 | D | Room 101 | Wall | CMU Block | Brown | Intact | 3.26 | | |
| 30 | 1 | A | Room 101 B | Wall | Concrete | White | Intact | 0.01 | | |
| 31 | 1 | B | Room 101 B | Wall | Gypsum Board | White | Intact | ND | | |
| 32 | 1 | C | Room 101 B | Wall | Metal | White | Fair | 0.19 | | |
| 33 | 1 | D | Room 101 B | Wall | Metal | White | Fair | 0.03 | | |
| 34 | 1 | D | Room 101 B | Door | Metal | Light Brown | Intact | ND | | |
| 35 | 1 | D | Room 101 B | Door Frame | Metal | Light Brown | Intact | 3.95 | | |

| Test Number | Floor | Side | Location | Component | Substrate | Color | Condition | Lead Concentration mg/cm² | Sample Code | Sample Number |
|---|---|---|---|---|---|---|---|---|---|---|
| 36 | 1 | D | Room 101 B | Ladder | Metal | White | Intact | 5.00 | | |
| 37 | 1 | A | Room 102 | Wall | Gypsum Board | White | Intact | ND | | |
| 38 | 1 | B | Room 102 | Wall | Gypsum Board | White | Intact | ND | | |
| 39 | 1 | C | Room 102 | Wall | Gypsum Board | White | Intact | ND | | |
| 40 | 1 | D | Room 102 | Wall | Gypsum Board | White | Intact | ND | | |
| 41 | 1 | D | Room 102 | Window Frame | Metal | Black | Intact | ND | | |
| 42 | 1 | D | Room 102 | Door Frame | Wood | Brown | Intact | 2.65 | | |
| 43 | 1 | D | Room 102 | Door | Metal | Brown | Intact | ND | | |
| 44 | 1 | A | Room 103 | Wall | Gypsum Board | White | Intact | ND | | |
| 45 | 1 | B | Room 103 | Wall | Gypsum Board | White | Intact | ND | | |
| 46 | 1 | C | Room 103 | Wall | Gypsum Board | White | Intact | ND | | |
| 47 | 1 | D | Room 103 | Wall | Gypsum Board | White | Intact | ND | | |
| 48 | 1 | A | Room 104 | Wall | Gypsum Board | White | Intact | ND | | |
| 49 | 1 | B | Room 104 | Door Frame | Metal | Brown | Intact | 0.15 | | |
| 50 | 1 | B | Room 104 | Wall | Gypsum Board | White | Intact | ND | | |
| 51 | 1 | C | Room 104 | Wall | Gypsum Board | White | Intact | ND | | |
| 52 | 1 | D | Room 104 | Wall | Gypsum Board | White | Intact | ND | | |
| 53 | 1 | A | Room 105 | Wall | Gypsum Board | White | Intact | ND | | |
| 54 | 1 | B | Room 105 | Door Frame | Metal | Brown | Intact | 0.11 | | |
| 55 | 1 | B | Room 105 | Wall | Gypsum Board | White | Intact | ND | | |
| 56 | 1 | C | Room 105 | Wall | Gypsum Board | White | Intact | ND | | |
| 57 | 1 | D | Room 105 | Wall | Gypsum Board | White | Intact | ND | | |
| 58 | 1 | A | Room 106 | Wall | Gypsum Board | White | Intact | ND | | |
| 59 | 1 | B | Room 106 | Door Frame | Metal | Brown | Intact | ND | | |
| 60 | 1 | B | Room 106 | Wall | Gypsum Board | White | Intact | ND | | |
| 61 | 1 | C | Room 106 | Wall | Gypsum Board | White | Intact | ND | | |
| 62 | 1 | D | Room 106 | Wall | Gypsum Board | White | Intact | ND | | |
| 63 | 1 | A | Room 107 | Wall | Gypsum Board | White | Intact | ND | | |
| 64 | 1 | B | Room 107 | Door Frame | Metal | Brown | Intact | ND | | |
| 65 | 1 | B | Room 107 | Wall | Gypsum Board | White | Intact | ND | | |
| 66 | 1 | C | Room 107 | Wall | Gypsum Board | Blue | Intact | ND | | |
| 67 | 1 | D | Room 107 | Wall | Gypsum Board | White | Intact | ND | | |
| 68 | 1 | D | Room 107 | Window Frame | Metal | Brown | Intact | ND | | |
| 69 | 1 | A | Room 108 | Wall | Gypsum Board | Blue | Intact | ND | | |
| 70 | 1 | A | Room 108 | Door Frame | Metal | Black | Intact | ND | | |
| 71 | 1 | B | Room 108 | Door Frame | Wood | Brown | Intact | 0.19 | | |
| 72 | 1 | B | Room 108 | Wall | Gypsum Board | Blue | Intact | ND | | |
| 73 | 1 | C | Room 108 | Wall | Gypsum Board | Blue | Intact | ND | | |

APPENDIX B - FOR INFORMATION ONLY

| Test Number | Floor | Side | Location | Component | Substrate | Color | Condition | Lead Concentration mg/cm² | Sample Code | Sample Number |
|---|---|---|---|---|---|---|---|---|---|---|
| 74 | 1 | D | Room 108 | Wall | Gypsum Board | Blue | Intact | ND | | |
| 75 | 1 | D | Room 108 | Door Frame | Wood | Black | Intact | 3.78 | | |
| 76 | 1 | D | Room 108 | Door | Metal | Black | Intact | ND | | |
| 77 | 1 | A | Room 109 | Wall | Gypsum Board | White | Intact | ND | | |
| 78 | 1 | B | Room 109 | Wall | Gypsum Board | White | Intact | ND | | |
| 79 | 1 | C | Room 109 | Wall | Gypsum Board | White | Intact | ND | | |
| 80 | 1 | D | Room 109 | Door Frame | Metal | Brown | Intact | ND | | |
| 81 | 1 | D | Room 109 | Wall | Gypsum Board | White | Intact | ND | | |
| 82 | 1 | A | Room 110 | Wall | CMU Block | Off White | Intact | 0.01 | | |
| 83 | 1 | B | Room 110 | Wall | CMU Block | Blue/Green | Intact | 0.08 | | |
| 84 | 1 | C | Room 110 | Wall | CMU Block | Green | Intact | 0.01 | | |
| 85 | 1 | D | Room 110 | Wall | Brick | Green/Grey | Intact | 0.11 | | |
| 86 | 1 | D | Room 110 | Large Sliding Door | Metal | Green | Intact | 5.00 | | |
| 87 | 1 | D | Room 110 | Sliding Door Frame | Metal | Green | Intact | 0.20 | | |
| 88 | 1 | D | Room 110 | Electrical Conduit | Metal | Grey | Intact | 0.14 | | |
| 89 | 1 | D | Room 110 | Louvre | Metal | Cream | Intact | 1.71 | | |
| 90 | 1 | A | Room 111 | Wall | Brick | Beige | Intact | 0.13 | | |
| 91 | 1 | A | Room 111 | Door | Metal | Beige | Intact | 3.43 | | |
| 92 | 1 | A | Room 111 | Door Frame | Metal | Beige | Intact | 2.77 | | |
| 93 | 1 | B | Room 111 | Wall | Brick | Beige | Intact | 0.21 | | |
| 94 | 1 | C | Room 111 | Wall | Concrete | Beige | Intact | 0.06 | | |
| 95 | 1 | D | Room 111 | Wall | CMU Block | Beige | Intact | 0.14 | | |
| 96 | 1 | D | Room 111 | Door | Metal | Beige | Intact | 5.00 | | |
| 97 | 1 | D | Room 111 | Door Frame | Metal | Beige | Intact | 0.09 | | |
| 98 | 1 | A | Room 114 | Wall | Gypsum Board | Light Blue | Intact | ND | | |
| 99 | 1 | A | Room 114 | Door | Metal | Brown | Intact | ND | | |
| 100 | 1 | A | Room 114 | Door Frame | Metal | Brown | Intact | ND | | |
| 101 | 1 | B | Room 114 | Wall | Gypsum Board | Light Blue | Intact | ND | | |
| 102 | 1 | C | Room 114 | Wall | Gypsum Board | Light Blue | Intact | ND | | |
| 103 | 1 | D | Room 114 | Wall | Gypsum Board | Light Blue | Intact | ND | | |
| 104 | 1 | | Calibration | | | | | Passed | | |
| 105 | 1 | | Calibration | | | | | Passed | | |
| 106 | 1 | A | Room 126 | Wall | CMU Block | Brown | Intact | 0.303 | | |
| 107 | 1 | B | Room 126 | Wall | CMU Block | Brown | Intact | 0.752 | | |
| 108 | 1 | C | Room 126 | Wall | CMU Block | Brown | Intact | 0.878 | | |
| 109 | 1 | D | Room 126 | Wall | CMU Block | Brown | Intact | 0.712 | | |
| 110 | 1 | A | Room 126 | Wall | CMU Block | Yellow | Intact | 0.105 | | |
| 111 | 1 | B | Room 126 | Wall | CMU Block | Yellow | Intact | 0.204 | | |

APPENDIX B - FOR INFORMATION ONLY

| Test Number | Floor | Side | Location | Component | Substrate | Color | Condition | Lead Concentration mg/cm² | Sample Code | Sample Number |
|---|---|---|---|---|---|---|---|---|---|---|
| 112 | 1 | C | Room 126 | Wall | CMU Block | Yellow | Intact | 0.196 | | |
| 113 | 1 | D | Room 126 | Wall | CMU Block | Yellow | Intact | 0.708 | | |
| 114 | 1 | C | Room 126 | Door Frame | Metal | Brown | Intact | 0.021 | | |
| 115 | 1 | A | Room 129 | Wall | CMU Block | Brown | Intact | 0.674 | | |
| 116 | 1 | B | Room 129 | Wall | CMU Block | Brown | Intact | 0.568 | | |
| 117 | 1 | C | Room 129 | Wall | CMU Block | Brown | Intact | 0.491 | | |
| 118 | 1 | D | Room 129 | Wall | CMU Block | Brown | Intact | 0.514 | | |
| 119 | 1 | A | Room 129 | Wall | CMU Block | Yellow | Intact | 0.242 | | |
| 120 | 1 | B | Room 129 | Wall | CMU Block | Yellow | Intact | 0.298 | | |
| 121 | 1 | C | Room 129 | Wall | CMU Block | Yellow | Intact | 0.157 | | |
| 122 | 1 | D | Room 129 | Wall | CMU Block | Yellow | Intact | 0.587 | | |
| 123 | | C | Room 129 | Door Frame | Metal | Brown | Intact | 0.254 | | |
| 124 | | A | Room 130 | Wall | CMU Block | Yellow | Poor | 1.147 | | |
| 125 | | B | Room 130 | Wall | CMU Block | Yellow | Poor | 0.382 | | |
| 126 | | C | Room 130 | Wall | CMU Block | Yellow | Poor | 0.150 | | |
| 127 | | D | Room 130 | Wall | CMU Block | Yellow | Poor | 1.040 | | |
| 128 | | A | Room 130 | Wall | CMU Block | Brown | Poor | 2.17 | | |
| 129 | 1 | B | Room 130 | Wall | CMU Block | Brown | Poor | 4.39 | | |
| 130 | 1 | D | Room 130 | Wall | CMU Block | Brown | Poor | 2.23 | | |
| 131 | 1 | C | Room 130 | Wall | CMU Block | Green | Poor | 0.982 | | |
| 132 | 1 | A | Room 131 | Wall | CMU Block | White | Poor | 5 | | |
| 133 | 1 | B | Room 131 | Wall | CMU Block | White | Poor | 4.76 | | |
| 134 | 1 | C | Room 131 | Wall | CMU Block | White | Poor | 4.19 | | |
| 135 | 1 | D | Room 131 | Wall | CMU Block | White | Poor | 4.10 | | |
| 136 | 1 | B | Room 131 | Window Frame | Metal | Brown | Intact | ND | | |
| 137 | 1 | A | Room 132 | Wall | CMU Block | Brown | Intact | 0.803 | | |
| 138 | 1 | B | Room 132 | Wall | CMU Block | Beige | Intact | 0.522 | | |
| 139 | 1 | C | Room 132 | Wall | CMU Block | Salmon | Intact | 0.202 | | |
| 140 | 1 | D | Room 132 | Wall | CMU Block | White | Intact | 0.204 | | |
| 141 | 1 | D | Room 132 | Door | Metal | Grey | Intact | ND | | |
| 142 | 1 | D | Room 132 | Door Frame | Metal | Brown | Intact | 0.497 | | |
| 143 | 1 | C | Room 132 | Window Frame | Metal | Brown | Intact | ND | | |
| 144 | 1 | | Calibration | | | | | Passed | | |

APPENDIX B - FOR INFORMATION ONLY

# APPENDIX D

## BUILDING B7504, PRIDE HANGAR, ELLSWORTH AFB, SOUTH DAKOTA
## LEAD CONTAINING PAINT SAMPLING SUMMARY AND LABORATORY REPORT

| SAMPLE NUMBER | SAMPLE LOCATION | COMPONENT | SUBSTRATE | COLOR | CONDITION | RESULT (mg/kg) |
|---|---|---|---|---|---|---|
| P-01 | Room 101, South Wall | Wall | Drywall | White | Intact | 2 |

**EMSL Analytical, Inc.**
**6340 CastlePlace Dr., Indianapolis, IN 46250**
**Phone: (317) 803-2997 Fax: (317) 803-3047 Email: indianapolislab@emsl.com**

Attn: **Brian Ramsell**
**Terracon**
**1505 Old Happy Jack Road**
**Cheyenne, WY 82001**
Phone: (307) 632-9224
Fax: (307) 635-5756

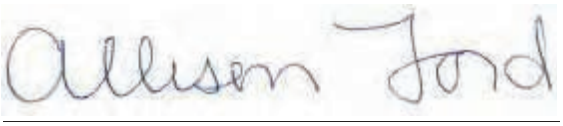
10/13/2021

The following analytical report covers the analysis performed on samples submitted to EMSL Analytical, Inc. on 10/12/2021. The results are tabulated on the attached data pages for the following client designated project:

**24217029**

The reference number for these samples is EMSL Order #162123968. Please use this reference when calling about these samples. If you have any questions, please do not hesitate to contact me at (317) 803-2997.

Approved By:



Allison Ford, Chemistry Lab Manager

Chemical Testing
2845.25

The samples associated with this report were received in good condition unless otherwise noted. This report relates only to those items tested as received by the laboratory. This report may not be reproducted except in full and without written approval by EMSL Analytical, Inc. A2LA accredited chemical testing laboratory for Metals in Solids and Liquids by Inductively Coupled Plasma (ICP), as well as Mercury by Cold Vapor Atomic Absorption (CVAA).

**EMSL Analytical, Inc.**
**6340 CastlePlace Dr., Indianapolis, IN 46250**
Phone/Fax: (317) 803-2997 / (317) 803-3047
http://www.EMSL.com indianapolislab@emsl.com

| | |
|---|---|
| EMSL Order: | 162123968 |
| CustomerID: | TRHQ42D |
| CustomerPO: | 24217029 |
| ProjectID: | |

Attn: **Brian Ramsell**
**Terracon**
**1505 Old Happy Jack Road**
**Cheyenne, WY 82001**

| | |
|---|---|
| Phone: | (307) 632-9224 |
| Fax: | (307) 635-5756 |
| Received: | 10/12/2021 09:15 AM |
| Collected: | 9/1/2021 |

Project: **24217029**

## Analytical Results

***Client Sample Description*** 7504-PB-01
Honor Guard Offices, Room 101 ***Collected:*** 9/1/2021 ***Lab ID:*** *162123968-0001*

| *Method* | *Parameter* | *Result* | *RL* | *Units* | *Prep Date & Analyst* | *Analysis Date & Analyst* |
|---|---|---|---|---|---|---|
| **METALS** | | | | | | |
| 3050B/6010D | Lead | 2.0 | 1.0 | mg/Kg | 10/12/2021 SD | 10/12/2021 SD |

**Definitions:**

MDL - method detection limit
J - Result was below the reporting limit, but at or above the MDL
ND - indicates that the analyte was not detected at the reporting limit
RL - Reporting Limit (Analytical)
D - Dilution Sample required a dilution which was used to calculate final results

# APPENDIX E

## BUILDING B7504, PRIDE HANGAR, ELLSWORTH AFB, SOUTH DAKOTA
## ELEMENTAL MERCURY SAMPLING SUMMARY AND LABORATORY REPORT

| SAMPLE NUMBER | MATERIAL DESCRIPTION | SAMPLE LOCATION | RESULT (mg/Kg) | REPORTING LIMIT (mg/Kg) |
|---|---|---|---|---|
| 7504-HG-01 | Rubberized Indoor Track | Room 100 | 76 | 6.1 |

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077
Phone: (856) 303-2500 Fax: (856) 858-4571 Email: EnvChemistry2@emsl.com

Attn: **Brian Ramsell**
**Terracon**
**1505 Old Happy Jack Road**
**Cheyenne, WY 82001**
Phone: (307) 632-9224
Fax: (307) 635-5756

9/16/2021

The following analytical report covers the analysis performed on samples submitted to EMSL Analytical, Inc. on 9/9/2021. The results are tabulated on the attached data pages for the following client designated project:

**24217029**

The reference number for these samples is EMSL Order #012110244. Please use this reference when calling about these samples. If you have any questions, please do not hesitate to contact me at (856) 303-2500.

Approved By:

Phillip Worby, Environmental Chemistry
Laboratory Director

The test results contained within this report meet the requirements of NELAP and/or the specific certification program that is applicable, unless otherwise noted.
NELAP Certifications: NJ 03036, NY 10872, PA 68-00367, CA ELAP 1877

The samples associated with this report were received in good condition unless otherwise noted. This report relates only to those items tested as received by the laboratory. The QC data associated with the sample results meet the recovery and precision requirements established by the NELAP, unless specifically indicated. All results for soil samples are reported on a dry weight basis, unless otherwise noted. This report may not be reproduced except in full and without written approval by EMSL Analytical, Inc.

**EMSL Analytical, Inc.**
**200 Route 130 North, Cinnaminson, NJ 08077**
Phone/Fax: (856) 303-2500 / (856) 858-4571
http://www.EMSL.com EnvChemistry2@emsl.com

| | |
|---|---|
| EMSL Order: | 012110244 |
| CustomerID: | TRHQ42D |
| CustomerPO: | |
| ProjectID: | |

Attn: **Brian Ramsell**
**Terracon**
**1505 Old Happy Jack Road**
**Cheyenne, WY 82001**

Phone: (307) 632-9224
Fax: (307) 635-5756
Received: 09/09/21 10:00 AM

Project: **24217029**

## Analytical Results

***Client Sample Description*** 7504-HG-01
Bldg 7504 Track

***Collected:*** 9/1/2021

***Lab ID:*** *012110244-0001*

| *Method* | *Parameter* | *Result* | *RL* | *Units* | *Prep Date & Analyst* | *Analysis Date & Analyst* |
|---|---|---|---|---|---|---|
| **METALS** | | | | | | |
| Mercury by EPA 7471B | Mercury | 76 D | 6.1 | mg/Kg | 9/14/2021 JD | 09/14/21 12:06 JD |

**Definitions:**

MDL - method detection limit
J - Result was below the reporting limit, but at or above the MDL
ND - indicates that the analyte was not detected at the reporting limit
RL - Reporting Limit (Analytical)
D - Dilution Sample required a dilution which was used to calculate final results

## APPENDIX F

## BUILDING B7504, PRIDE HANGAR, ELLSWORTH AFB, SOUTH DAKOTA
## PCB SAMPLING SUMMARY AND LABORATORY REPORT

| SAMPLE NUMBER | MATERIAL DESCRIPTION | SAMPLE LOCATION | RESULT (mg/Kg) | PARAMETER | REPORTING LIMIT (mg/Kg) |
|---|---|---|---|---|---|
| PCBC-01 | Gray Glazing | Room 112, South Window | ND | N/A | 0.91 |
| PCBC-02 | White Caulk | Exterior, East Side of Building, Window opposite Room 131 | 1.2 | Aroclor-1254 | 0.91 |

ND – None detected above the laboratory reporting limit

EMSL Analytical, Inc.
200 Route 130 North, Cinnaminson, NJ 08077
Phone: (856) 303-2500 Fax: (856) 858-4571 Email: EnvChemistry2@emsl.com

Attn: **Brian Ramsell**
**Terracon**
**1505 Old Happy Jack Road**
**Cheyenne, WY 82001**
Phone: (307) 632-9224
Fax: (307) 635-5756

9/23/2021

The following analytical report covers the analysis performed on samples submitted to EMSL Analytical, Inc. on 9/9/2021. The results are tabulated on the attached data pages for the following client designated project:

**24217029**

The reference number for these samples is EMSL Order #012110276. Please use this reference when calling about these samples. If you have any questions, please do not hesitate to contact me at (856) 303-2500.

Approved By:

Phillip Worby, Environmental Chemistry
Laboratory Director

The test results contained within this report meet the requirements of NELAP and/or the specific certification program that is applicable, unless otherwise noted.
NELAP Certifications: NJ 03036, NY 10872, PA 68-00367, CA ELAP 1877

The samples associated with this report were received in good condition unless otherwise noted. This report relates only to those items tested as received by the laboratory. The QC data associated with the sample results meet the recovery and precision requirements established by the NELAP, unless specifically indicated. All results for soil samples are reported on a dry weight basis, unless otherwise noted. This report may not be reproduced except in full and without written approval by EMSL Analytical, Inc.

**EMSL Analytical, Inc.**
**200 Route 130 North, Cinnaminson, NJ 08077**
Phone/Fax: (856) 303-2500 / (856) 858-4571
http://www.EMSL.com EnvChemistry2@emsl.com

EMSL Order: 012110276
CustomerID: TRHQ42D
CustomerPO:
ProjectID:

Attn: **Brian Ramsell**
**Terracon**
**1505 Old Happy Jack Road**
**Cheyenne, WY 82001**

Phone: (307) 632-9224
Fax: (307) 635-5756
Received: 9/9/2021 10:00 AM

Project: **24217029**

## Analytical Results

***Client Sample Description*** 7504-PCBC-01 ***Collected:*** 9/1/2021 ***Lab ID:*** *012110276-0001*

| *Method* | *Parameter* | *Result* | *RL* | *Units* | *Prep Date & Analyst* | | *Analysis Date & Analyst* | |
|---|---|---|---|---|---|---|---|---|
| **GC-SVOA** | | | | | | | | |
| 3540C/8082A | Aroclor-1016 | ND D | 0.99 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1221 | ND D | 0.99 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1232 | ND D | 0.99 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1242 | ND D | 0.99 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1248 | ND D | 0.99 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1254 | ND D | 0.99 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1260 | ND D | 0.99 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1262 | ND D | 0.99 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1268 | ND D | 0.99 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |

***Client Sample Description*** 7504-PCBC-02 ***Collected:*** 9/1/2021 ***Lab ID:*** *012110276-0002*

| *Method* | *Parameter* | *Result* | *RL* | *Units* | *Prep Date & Analyst* | | *Analysis Date & Analyst* | |
|---|---|---|---|---|---|---|---|---|
| **GC-SVOA** | | | | | | | | |
| 3540C/8082A | Aroclor-1016 | ND D | 0.91 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1221 | ND D | 0.91 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1232 | ND D | 0.91 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1242 | ND D | 0.91 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1248 | ND D | 0.91 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1254 | 1.2 D | 0.91 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1260 | ND D | 0.91 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |
| 3540C/8082A | Aroclor-1262 | ND D | 0.91 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |

**EMSL Analytical, Inc.**
**200 Route 130 North, Cinnaminson, NJ 08077**
Phone/Fax: (856) 303-2500 / (856) 858-4571
http://www.EMSL.com EnvChemistry2@emsl.com

EMSL Order: 012110276
CustomerID: TRHQ42D
CustomerPO:
ProjectID:

Attn: **Brian Ramsell**
**Terracon**
**1505 Old Happy Jack Road**
**Cheyenne, WY 82001**

Phone: (307) 632-9224
Fax: (307) 635-5756
Received: 9/9/2021 10:00 AM

Project: **24217029**

## Analytical Results

***Client Sample Description*** 7504-PCBC-02 ***Collected:*** 9/1/2021 ***Lab ID:*** *012110276-0002*

| *Method* | *Parameter* | *Result* | *RL* | *Units* | *Prep Date & Analyst* | | *Analysis Date & Analyst* | |
|---|---|---|---|---|---|---|---|---|
| **GC-SVOA** | | | | | | | | |
| 3540C/8082A | Aroclor-1268 | ND D | 0.91 | mg/Kg | 9/13/2021 | ER | 9/14/2021 00:00 | EH |

**Definitions:**

MDL - method detection limit
J - Result was below the reporting limit, but at or above the MDL
ND - indicates that the analyte was not detected at the reporting limit
RL - Reporting Limit (Analytical)
D - Dilution Sample required a dilution which was used to calculate final results

## APPENDIX G

## BUILDING B7504, PRIDE HANGAR, ELLSWORTH AFB, SOUTH DAKOTA
## RADON TESTING SUMMARY AND LABORATORY REPORT

| Sample Location (Room) | Test ID | Start Test | | End Test | | Laboratory Result (pCi/L) |
|---|---|---|---|---|---|---|
| | | Date | Time | Date | Time | |
| Room 123, Vacant, Unfinished Room, East Side | 2967202 | 8-31-21 | 1534 | 9-2-21 | 1604 | 2.1 |
| Room 126, Vacant, Unfinished Room, Center | 2967182 | 8-31-21 | 1558 | 9-2-21 | 1558 | 3.7 |
| Room 131, Vacant, Unfinished Room, Center | 2964972 | 8-31-21 | 1600 | 9-2-21 | 1600 | 1.7 |
| Room 132, Vacant, Unfinished Room, Center | 2967189 | 8-31-21 | 1602 | 9-2-21 | 1602 | 1.8 |
| Room 104, Honor Guard Game Room, Southwest Corner | 2967184 | 8-31-21 | 1607 | 9-2-21 | 1608 | 1.6 |
| Room 105, Honor Guard Ready Room, Northeast Corner | 2964984 | 8-31-21 | 1608 | 9-2-21 | 1609 | 1.7 |
| Room 106, Honor Guard Office, Southeast Corner | 2965007 | 8-31-21 | 1609 | 9-2-21 | 1611 | 1.6 |
| Room 109, Honor Guard Storage Room North Center | 2967204 | 8-31-21 | 1612 | 9-2-21 | 1612 | 1.3 |
| Room 109, Honor Guard Storage Room North Center (Duplicate Sample) | 2967181 | 8-31-21 | 1613 | 9-2-21 | 1613 | 1.6 |
| Blank Sample | 2967183 | 8-31-21 | 13:19 | 9-2-21 | 1604 | 0.1 |

PC2109100025

RTCA RADON TESTING CORPORATION OF AMERICA

Site Radon Inspection Report

Date : 09/10/2021

Mr. Brian Ramsell
TERRACON CONSULTANTS
1505 Old Happy Jack Road
Cheyenne, WY 82001-

Client: Project #24217029
Test Location: Ellsworth AFB
Building B7504

Individual Canister Results

| | | | |
|---|---|---|---|
| Canister ID# : | 2964972 | Test Start : | 08/31/2021 @ 16:00 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 16:00 |
| Location : | Room 131 | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 1.7 pCi/L | Analyzed: | 09/10/2021 @ 11:32 |
| Error for Measurement is: | ± 0.4 pCi/L | | |

| | | | |
|---|---|---|---|
| Canister ID# : | 2964984 | Test Start : | 08/31/2021 @ 16:08 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 16:09 |
| Location : | Room 105 | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 1.7 pCi/L | Analyzed: | 09/10/2021 @ 11:32 |
| Error for Measurement is: | ± 0.5 pCi/L | | |

| | | | |
|---|---|---|---|
| Canister ID# : | 2965007 | Test Start : | 08/31/2021 @ 16:09 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 16:11 |
| Location : | Room 106 | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 1.6 pCi/L | Analyzed: | 09/10/2021 @ 11:32 |
| Error for Measurement is: | ± 0.4 pCi/L | | |

| | | | |
|---|---|---|---|
| Canister ID# : | 2967181 | Test Start : | 08/31/2021 @ 16:13 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 16:13 |
| Location : | Room 126 | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 1.6 pCi/L | Analyzed: | 09/10/2021 @ 11:19 |
| Error for Measurement is: | ± 0.5 pCi/L | | |

| | | | |
|---|---|---|---|
| Canister ID# : | 2967182 | Test Start : | 08/31/2021 @ 15:58 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 15:58 |
| Location : | Room 126 | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 3.7 pCi/L | Analyzed: | 09/10/2021 @ 11:20 |
| Error for Measurement is: | ± 0.5 pCi/L | | |

| | | | |
|---|---|---|---|
| Canister ID# : | 2967183 | Test Start : | 08/31/2021 @ 16:00 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 16:00 |
| Location : | BLANK | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 0.1 pCi/L | Analyzed: | 09/10/2021 @ 11:20 |
| Error for Measurement is: | ± 0.4 pCi/L | | |

National Radon Safety Board NRSB Certified Radon Professionals

Andreas C. George

Andreas C. George
Radon Measurement Specialist
NJ MES 11089

Dante Galan
Laboratory Director

NRSB ARL0001
NYS ELAP ID: 10806
PADEP ID: 0346
NJDEP ID: NY933
NJ MEB 90036
FL DOH RB1609
IL RNL2000201

(914)345-3380
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2 Hayes Street, Elmsford, NY 10523
www.rtca.com

RTCA RADON TESTING CORPORATION OF AMERICA

Site Radon Inspection Report

Date : 09/10/2021

Mr. Brian Ramsell
TERRACON CONSULTANTS
1505 Old Happy Jack Road
Cheyenne, WY 82001-

Client: Project #24217029
Test Location: Ellsworth AFB
Building B7504

Individual Canister Results

| | | | |
|---|---|---|---|
| Canister ID# : | 2967184 | Test Start : | 08/31/2021 @ 16:07 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 16:08 |
| Location : | Room 104 | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 1.6 pCi/L | Analyzed: | 09/10/2021 @ 11:19 |
| Error for Measurement is: | ± 0.5 pCi/L | | |

| | | | |
|---|---|---|---|
| Canister ID# : | 2967189 | Test Start : | 08/31/2021 @ 16:02 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 16:02 |
| Location : | Room 132 | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 1.8 pCi/L | Analyzed: | 09/10/2021 @ 12:04 |
| Error for Measurement is: | ± 0.5 pCi/L | | |

| | | | |
|---|---|---|---|
| Canister ID# : | 2967202 | Test Start : | 08/31/2021 @ 15:34 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 16:04 |
| Location : | Room 123 | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 2.1 pCi/L | Analyzed: | 09/10/2021 @ 11:32 |
| Error for Measurement is: | ± 0.5 pCi/L | | |

| | | | |
|---|---|---|---|
| Canister ID# : | 2967204 | Test Start : | 08/31/2021 @ 16:13 |
| Canister Type : | Charcoal Canister 4 inch | Test Stop : | 09/02/2021 @ 16:13 |
| Location : | Room 109 | Received: | 09/10/2021 @ 12:06 |
| Radon Level : | 1.3 pCi/L | Analyzed: | 09/10/2021 @ 12:04 |
| Error for Measurement is: | ± 0.5 pCi/L | | |

National Radon Safety Board NRSB Certified Radon Professionals

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NJDEP ID: NY933
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PC2109100025

RTCA RADON TESTING CORPORATION OF AMERICA

Site Radon Inspection Report

Date : 09/10/2021

Mr. Brian Ramsell
TERRACON CONSULTANTS
1505 Old Happy Jack Road
Cheyenne, WY 82001-

Client: Project #24217029
Test Location: Ellsworth AFB
Building B7504

## Individual Canister Results

The reported results indicate that radon levels in the building tested are below the United States Environmental Protection Agency (EPA) action level of 4.0 picoCuries per liter of air (pCi/L). The EPA recommends retesting if your living patterns change and you begin occupying a lower level of the building, such as a basement or if major remodeling is done.

General radon information may be obtained by consulting the EPA booklet: A Citizen's Guide to Radon (www.epa.gov/radon/pubs/citguide.html). To request a copy or for further information, please contact your state health department. The EPA maintains a radon information website, including copies of its publications, at www.epa.gov/iaq/radon.

**For New Jersey clients:** Please see the attached guidance document entitled Radon Testing and Mitigation: The Basics for further information.

**For New York clients:** If the radon level of one or more testing devices is equal to or exceeds 20 pCi/L please contact the New York State Department of Health, Bureau of Environmental Radiation Protection, for technical advice and assistance at 518-402-7556 or toll free1-800-458-1158.

**PLEDGE OF ASSURED QUALITY**

All procedures used for generating this report are in complete accordance with the current EPA protocols for the analysis of radon in air (EPA 402-R-92-004). The analytical results relate only to the samples tested, in the condition received by the lab, and that calculations were based upon the information supplied by client. RTCA and its personnel do not assume responsibility or liability, collectively and individually, for analysis results when detectors have been improperly handled or placed by the consumer, nor does RTCA and its personnel accept responsibility for any financial or health consequences of subsequent action or lack of action, taken by the customer or it's consultants based on RTCA-provided results.

National Radon Safety Board NRSB Certified Radon Professionals

Andreas C. George

Andreas C. George
Radon Measurement Specialist
NJ MES 11089

Dante Galan
Laboratory Director

NRSB ARL0001
NYS ELAP ID: 10806
PADEP ID: 0346
NJDEP ID: NY933
NJ MEB 90036
FL DOH RB1609
IL RNL2000201

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Tel: 914-345-3380 - Fax: 914-345-8546

## Radon Testing Summary Sheet

**Contact:** Brian Ramsell
**Address:** 1505 Old Happy Jack Road
**City:** Cheyenne **State:** Wyoming **Zip:** 82001

**Company/Agency/Board of Ed:** Terracon Consultants
**Phone#:** (307)632-9224 **Fax:** (307)635-5756
**Email:** Brian.Ramsell@terracon.com

**Project Location:** Ellsworth AFB
**Project Building:** Bldg 7504
**Client Project No.:** 24217029

**Placed By:** Brian Ramsell **Retrieved by:** Brian Ramsell **Page(s):** 1 of 2

| Canister # | Room | Location | Test Type | Duplicate | Building Type | Floor Type | Test Conditions | Weather Conditions | Date Set | Time Set | Date Collected | Time Collected | Doors Closed | Windows Closed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2967202 | 123 | East side of room | Screening | No | Hanger | Slab | Closed | Windy | 8/31/2021 | 1534 | 9/2/2021 | 1604 | X | X |
| Bar Code Label | | REMOVE THIS PORTION AND KEEP FOR YOUR RECORDS 2967202 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |
| 2967182 | 126 | Center of room | Screening | No | Hanger | Slab | Closed | Windy | 8/31/2021 | 1558 | 9/2/2021 | 1558 | X | X |
| Bar Code Label | | REMOVE THIS PORTION AND KEEP FOR YOUR RECORDS 2967182 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |
| 2964972 | 131 | Center of room | Screening | No | Hanger | Slab | Closed | Windy | 8/31/2021 | 1600 | 9/2/2021 | 1600 | X | X |
| Bar Code Label | | FOR YOUR RECORDS 2964972 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |
| 2967189 | 132 | Center of room | Screening | No | Hanger | Slab | Closed | Windy | 8/31/2021 | 1602 | 9/2/2021 | 1602 | X | X |
| Bar Code Label | | REMOVE THIS PORTION AND KEEP FOR YOUR RECORDS 2967189 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |
| 2967184 | 104 | South West Corner | Screening | No | Hanger | Slab | Closed | Windy | 8/31/2021 | 1607 | 9/2/2021 | 1608 | X | N/A |
| Bar Code Label | | REMOVE THIS PORTION AND KEEP FOR YOUR RECORDS 2967184 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |
| 2964984 | 105 | North East Corner | Screening | No | Hanger | Slab | Closed | Windy | 8/31/2021 | 1608 | 9/2/2021 | 1609 | X | N/A |
| Bar Code Label | | REMOVE THIS PORTION AND KEEP FOR YOUR RECORDS 2964984 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |



APPENDIX B - FOR INFORMATION ONLY

RTCA®, Radon Testing Corporation of America

## Radon Testing Summary Sheet

Client Project No.: 24217029



| Canister # | Room | Location | Test Type | Duplicate | Building Type | Floor Type | Test Conditions | Weather Conditions | Date Set | Time Set | Date Collected | Time Collected | Doors Closed | Windows Closed |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2965007 | 106 | South East Corner | Screening | No | Hanger | Slab | Closed | Windy | 8/31/2021 | 1609 | 9/2/2021 | 1611 | X | N/A |
| Bar Code Label | | REMOVE THIS PORTION AND KEEP FOR YOUR RECORDS 2965007 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |
| 2967204 | 109 | North Center | Screening | No | Hanger | Slab | Closed | Windy | 8/31/2021 | 1612 | 9/2/2021 | 1612 | X | N/A |
| Bar Code Label | | REMOVE THIS PORTION AND KEEP FOR YOUR RECORDS 2967204 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |
| 2967181 | 109 | North Center | Screening | Yes | Hanger | Slab | Closed | Windy | 8/31/2021 | 1613 | 9/2/2021 | 1613 | X | N/A |
| Bar Code Label | | REMOVE THIS PORTION AND KEEP FOR YOUR RECORDS 2967181 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |
| 2967183 | Blank | | | | | | | | | | | | | |
| Bar Code Label | | REMOVE THIS PORTION AND KEEP FOR YOUR RECORDS 2967183 Client RADON TESTING CORP. OF AMERICA | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Bar Code Label | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Bar Code Label | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Bar Code Label | | | | | | | | | | | | | | |



APPENDIX B - FOR INFORMATION ONLY

# APPENDIX H

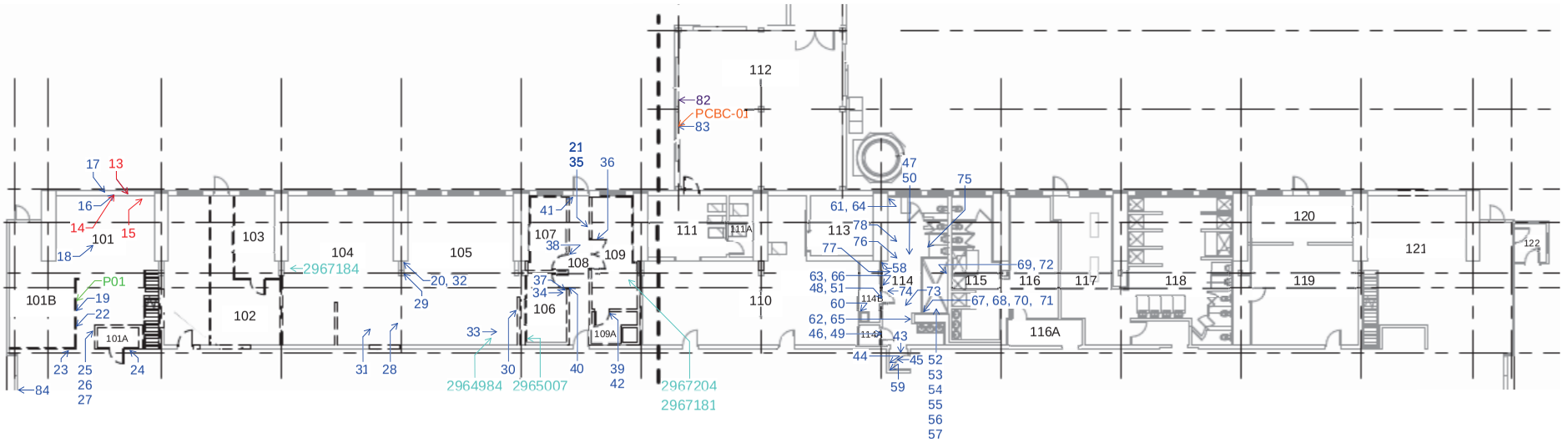
## DRAWINGS

| | | | | | |
|---|---|---|---|---|---|
| | Project Mngr: BKR | Project No: 2421729 | Consulting Engineers and Scientists | FLOOR PLAN AND PROJECT AREAS | FIG. No. |
| | Drawn By: BKR | Scale: Not to scale | | Building 7504 Pride Hanger | 1 |
| | Checked By: RJB | File No: 2421729 Fig. 1 | 1505 Old Happy Jack Road Cheyenne, Wyoming PH. (307) 632-9224 FAX (307) 635-5756 | Ellsworth Air Force Base, South Dakota | |
| | Approved By: RJB | Date: 10/14/2021 | | | |

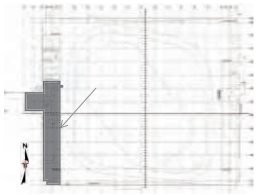
Legend
- Project Areas

| | | | | |
|---|---|---|---|---|
| | Project Mngr: BKR<br>Drawn By: BKR<br>Checked By: RJB<br>Approved By: RJB | Project No 2421702<br>Scale Not to scale<br>File No. 2421702 Fig. 1<br>Date: 10/14/2021 | Terracon<br>Consulting Engineers and Scientists<br>1505 Old Happy Jack Road Cheyenne, Wyoming<br>PH. (307) 632-9224 FAX (307) 635-5756 | ASBESTOS SAMPLE LOCATIONS - EAST SADDLEBAG BUILDING<br>Building 7504 Pride Hanger<br>Ellsworth Air Force Base, South Dakota | FIG. No.<br>2 |

Legend
## - ACM
## - Non-ACM
## - Trace Asbestos
## - PCB Sample Locations
## - Radon Test Locations




Project Area



ASBESTOS SAMPLE LOCATIONS - WEST SADDLEBAG BUILDING
Building 7504 Pride Hanger
Ellsworth Air Force Base, South Dakota

FIG. No. 3

Terracon
Consulting Engineers and Scientists
1505 Old Happy Jack Road
Cheyenne, Wyoming
PH: (307) 632-9224
FAX: (307) 635-7935

| | |
|---|---|
| Project No: | 24217029 |
| Scale: | Not to scale |
| File No: | 24217029 Fig. 1 |
| Date: | 10/14/2021 |
| Project Mngr: | BKR |
| Drawn By: | BKR |
| Checked By: | RJB |
| Approved By: | RJB |

# APPENDIX I

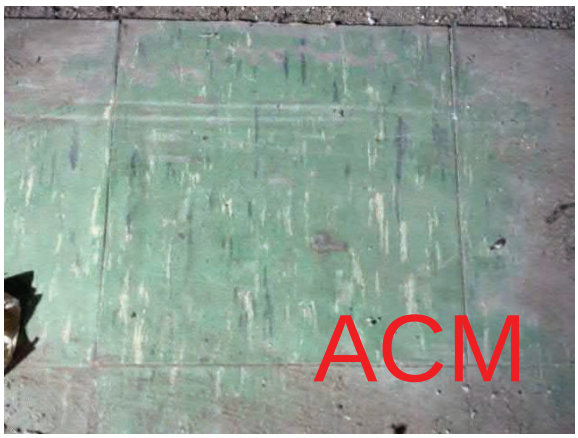
## PHOTOGRAPHS

1. HA 01-MG7 - Cream Mastic

2. HA 02-WB1 - Painted 5/8" White Drywall & White Taping Mud

3. HA 03-MG8 – Marigold Mastic

4. HA 04-MG8 – Cream Mastic




5. HA 05-FT1 - 9” x 9” Green VFT w/ Cream Streaks and Cream Mastic

6. HA 06-FT2 - 12” X 12” Brown Parquet Pattern VFT and Cream Mastic

7. HA 07-WB1 - Painted 5/8-inch White Drywall & White Taping Mud

8. HA 08-PL5 - Painted White Knockdown Texture

9. HA 09-SC7 - White Pipe Sealant (Pookie)

10. HA 10-FC3 - Yellow Mastic associated w/ 4" Gray Cove Base

11. HA 11-CT3 - 2' x 4' White LICP w/ Randomly Spaced Pits and Pinholes and Beveled Edge

12. HA 12-CT3 - 2' x 4' White LICP w/ Topographic Texture and Randomly Spaced Pinholes

13. HA 13-FC3 - Cream Mastic associated w/ 4" Gray Cove Base

14. HA 14-MG7 - Cream Mastic associated with Gray/Brown Multicolored Carpet

15. HA 15-FC5 - Gray Floor Leveling Compound

16. HA 16-MA3 - Gray Mortar associated w/ 1" x 1" Multi-Shade Brown Ceramic Floor Tile

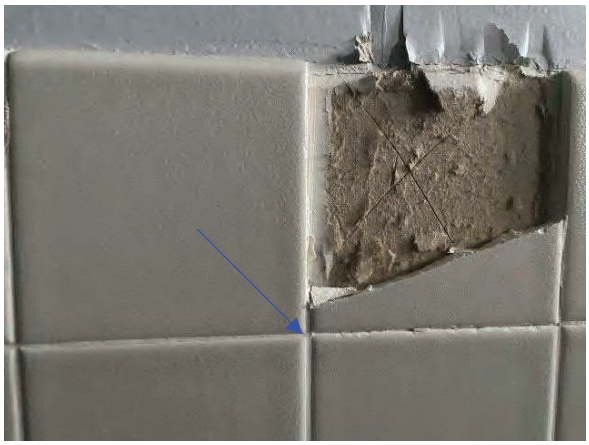
17. HA 17-MA4 - Gray Grout associated w/ 1" x 1" Multi-Shade Brown Ceramic Floor Tile

18. HA 18-MA3 - Gray Mortar associated w/ 12 x 12 Cream Ceramic Floor Tile

19. HA 19-MA4 - Gray Grout associated w/ 12 x 12 Cream Ceramic Floor Tile

20. HA 20-WB1- Painted 5/8-inch White Drywall & White Taping Mud

21. HA 21-MA3 - Yellow Mastic associated w/ 4 x 4 Cream Ceramic Wall Tile



22. HA 22-MA4 - White Grout associated w/ 4 x 4 Cream Ceramic Wall Tile

23. HA 23-MA3 - Yellow Mastic associated w/ 6" x 6" Cream Ceramic Wall Tile

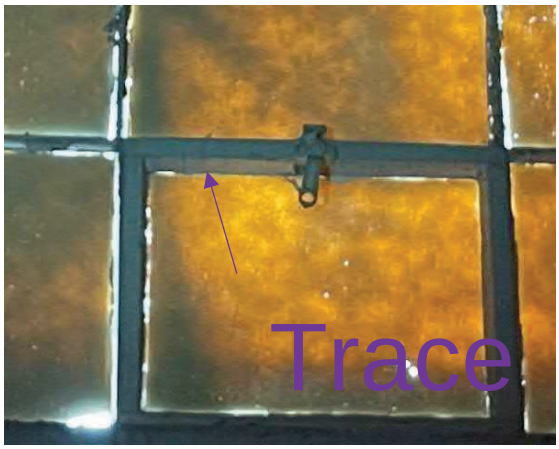
24. HA 24-MA4 – Gray Grout associated w/ 6" x 6" Cream Ceramic Wall Tile

25. HA 25-CT4 - 2' x 4' White LICP w/ Randomly Spaced Fissures and Pinholes

26. HA 26-MS5 - White Paper, Foil, and Black Felt-backed Pipe Insulation Wrap

No Photo

27. HA 27-CA1 - White Window Caulk




28. HA 28-SC1 - Gray Window Glazing

29. HA 29-WP1 – Black Woven Electrical Wiring

No Photo

Assumed ACM

30. HA 30-FD1 – Metal Fire Door

31. HA 31-FD1 - Metal Fire Door (Sliding Door)

# APPENDIX J

## ACCREDITATIONS

South Dakota
Department of Agriculture & Natural Resources

**ASBESTOS CERTIFICATION**

Brian Ramsell

has successfully completed the appropriate training in accordance with ARSD 74:31 and is certified in South Dakota as an:

| | |
|---|---|
| Inspector | Expires: 01/06/2022 |
| Management Planner | Expires: |
| Abatement Designer | Expires: |
| Contractor/Supervisor | Expires: |
| Worker | Expires: |

Certificate No. 8835

**Acclaim Environmental Services, Inc.**

Innovative Strategies | Effective Solutions

7959 Ulster Court, Thornton, Colorado 80602
Tel: 303.424.4647
www.acclaim-enviro.com
acclaim-enviro@comcast.net

**CERTIFIES THAT**

# BRIAN K. RAMSELL

Has successfully completed

The **EPA-Approved AHERA Annual Refresher Course** for

**INSPECTOR / MANAGEMENT PLANNER**

This course is EPA-approved under Section 206 of the Toxic Substances Control Act (TSCA), Title II, and meets the requirements of Colorado Regulation No. 8.

| | |
|---|---|
| Course Date: | 01/06/2021 |
| Exam Date: | N/A |
| Certificate No.: | AE21-002-BI/MP-R-03 |
| Expiration Date: | 01/06/2022 |

K. Jay Gale

**K. Jay Gale, President**

CO Live-Remote – COVID-19

*Acclaim Environmental is committed to providing high quality asbestos training, consulting, and environmental services, providing insight, innovative strategies, and effective solutions.*

South Dakota
Department of Agriculture & Natural Resources

**ASBESTOS CERTIFICATION**

Michael Fera

has successfully completed the appropriate training in accordance with ARSD 74:31 and is certified in South Dakota as an:

| | |
|---|---|
| ✓ Inspector | Expires: 10/16/2021 |
| __Management Planner | Expires: |
| __Abatement Designer | Expires: |
| __Contractor/Supervisor | Expires: |
| __Worker | Expires: |

Certificate No. 8866

CHC Training
Nationwide Training & Certification Experts

www.chctraining.com
303.412.6360
855.60.CERTIFY

1775 West 55th Avenue
Denver, CO 80221,
United States of America
Colorado State Approval No. 22651

# Certificate of Achievement

This certificate is awarded to:

## Michael Fera

In recognition of satisfactory completion of the EPA-approved asbestos initial training course under section 206 of the Toxic Substance Control Act (TSCA) and Colorado Regulation No. 8 entitled

## BUILDING INSPECTOR

| | |
|---|---|
| Course Dates: | September 21 - 23, 2020 |
| Examination Date: | September 23, 2020 |
| Expiration Date: | September 23, 2021 |
| Course Hours: | 24.0 |

Verify this Credential

*Danaya N. Benedetto*
CEO & Training Program Manager

Credential License ID:
23520312

CHC Training
Safety Quality Compliance Integrity
Est. 2007
Accredited Alumni

*John Peterson*
Instructor

CHC Training Certificate No.
I20-1138-AI-CO

Visit our Website

APPENDIX B - FOR INFORMATION ONLY

**United States Department of Commerce**
**National Institute of Standards and Technology**

# Certificate of Accreditation to ISO/IEC 17025:2017

**NVLAP LAB CODE: 500031-0**

## Eurofins EMLab P&K

Phoenix, AZ

*is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:*

## Asbestos Fiber Analysis

*This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).*

2021-01-01 through 2021-12-31

*Effective Dates*

*For the National Voluntary Laboratory Accreditation Program*

APPENDIX B - FOR INFORMATION ONLY

National Voluntary Laboratory Accreditation Program

# SCOPE OF ACCREDITATION TO ISO/IEC 17025:2017

**Eurofins EMLab P&K**
1501 W. Knudsen Dr.
Phoenix, AZ 85027-1307
Mr. Dan Shelby
Phone: 623-298-1015
Email: dshelby@emlabpk.com
http://www.emlab.com

## ASBESTOS FIBER ANALYSIS — NVLAP LAB CODE 500031-0

### Bulk Asbestos Analysis

| *Code* | *Description* |
|---|---|
| 18/A01 | EPA -- 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples |
| 18/A03 | EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials |

*For the National Voluntary Laboratory Accreditation Program*

# AIHA Laboratory Accreditation Programs, LLC

*acknowledges that*

## EMSL Analytical, Inc.

**6340 Castleplace Drive Indianapolis, IN 46250**

**Laboratory ID: LAP-157245**

along with all premises from which key activities are performed, as listed above, has fulfilled the requirements of the AIHA Laboratory Accreditation Programs (AIHA-LAP), LLC accreditation to the ISO/IEC 17025:2017 international standard, General Requirements for the Competence of Testing and Calibration Laboratories in the following:

### LABORATORY ACCREDITATION PROGRAMS

| | | |
|---|---|---|
| ☑ | **INDUSTRIAL HYGIENE** | Accreditation Expires: June 01, 2023 |
| ☑ | **ENVIRONMENTAL LEAD** | Accreditation Expires: June 01, 2023 |
| ☑ | **ENVIRONMENTAL MICROBIOLOGY** | Accreditation Expires: June 01, 2023 |
| ☐ | **FOOD** | Accreditation Expires: |
| ☐ | **UNIQUE SCOPES** | Accreditation Expires: |

Specific Field(s) of Testing (FoT)/Method(s) within each Accreditation Program for which the above named laboratory maintains accreditation is outlined on the attached Scope of Accreditation. Continued accreditation is contingent upon successful on-going compliance with ISO/IEC 17025:2017 and AIHA-LAP, LLC requirements. This certificate is not valid without the attached Scope of Accreditation. Please review the AIHA-LAP, LLC website (www.aihaaccreditedlabs.org) for the most current Scope.

Cheryl O. Morton

*Cheryl O Morton*
*Managing Director, AIHA Laboratory Accreditation Programs, LLC*

Revision19: 09/01/2020

Date Issued: 05/31/2021

APPENDIX B - FOR INFORMATION ONLY

# AIHA Laboratory Accreditation Programs, LLC

## SCOPE OF ACCREDITATION

**EMSL Analytical, Inc.**
6340 Castleplace Drive Indianapolis, IN 46250

**Laboratory ID: LAP-157245**
Issue Date: 05/31/2021

The laboratory is approved for those specific field(s) of testing/methods listed in the table below. Clients are urged to verify the laboratory's current accreditation status for the particular field(s) of testing/Methods, since these can change due to proficiency status, suspension and/or withdrawal of accreditation.

The EPA recognizes the AIHA-LAP, LLC ELLAP program as meeting the requirements of the National Lead Laboratory Accreditation Program (NLLAP) established under Title X of the Residential Lead-Based Paint Hazard Reduction Act of 1992 and includes paint, soil and dust wipe analysis. Air and composited wipes analyses are not included as part of the NLLAP.

### Environmental Lead Laboratory Accreditation Program (ELLAP)

### Initial Accreditation Date: 09/01/2002

| Component, parameter or characteristic tested | Technology sub-type/Detector | Method | Method Description *(for internal methods only)* |
|---|---|---|---|
| Airborne Dust | AA | NIOSH 7082 | N/A |
| Paint | AA | EPA SW-846 3050B | N/A |
| | | EPA SW-846 3051A | N/A |
| | | EPA SW-846 7000B | N/A |
| Settled Dust by Wipe | AA | EPA SW-846 3050B | N/A |
| | | EPA SW-846 3051A | N/A |
| | | EPA SW-846 7000B | N/A |
| Soil | AA | EPA SW-846 3050B | N/A |
| | | EPA SW-846 3051A | N/A |
| | | EPA SW-846 7000B | N/A |

A complete listing of currently accredited ELLAP laboratories is available on the AIHA-LAP, LLC website at: *http://www.aihaaccreditedlabs.org*

# AIHA Laboratory Accreditation Programs, LLC

*acknowledges that*

## EMSL Analytical, Inc.

**6340 Castleplace Drive Indianapolis, IN 46250**

**Laboratory ID: LAP-157245**

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### LABORATORY ACCREDITATION PROGRAMS

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| ☑ | **ENVIRONMENTAL LEAD** | Accreditation Expires: June 01, 2023 |
| ☑ | **ENVIRONMENTAL MICROBIOLOGY** | Accreditation Expires: June 01, 2023 |
| ☐ | **FOOD** | Accreditation Expires: |
| ☐ | **UNIQUE SCOPES** | Accreditation Expires: |

Specific Field(s) of Testing (FoT)/Method(s) within each Accreditation Program for which the above named laboratory maintains accreditation is outlined on the attached Scope of Accreditation. Continued accreditation is contingent upon successful on-going compliance with ISO/IEC 17025:2017 and AIHA-LAP, LLC requirements. This certificate is not valid without the attached Scope of Accreditation. Please review the AIHA-LAP, LLC website (www.aihaaccreditedlabs.org) for the most current Scope.

Cheryl O. Morton

*Cheryl O Morton*
*Managing Director, AIHA Laboratory Accreditation Programs, LLC*

Revision19: 09/01/2020

Date Issued: 05/31/2021

# AIHA Laboratory Accreditation Programs, LLC

## SCOPE OF ACCREDITATION

**EMSL Analytical, Inc.**
6340 Castleplace Drive Indianapolis, IN 46250

**Laboratory ID: LAP-157245**
Issue Date: 05/31/2021

The laboratory is approved for those specific field(s) of testing/methods listed in the table below. Clients are urged to verify the laboratory's current accreditation status for the particular field(s) of testing/Methods, since these can change due to proficiency status, suspension and/or withdrawal of accreditation.

### Industrial Hygiene Laboratory Accreditation Program (IHLAP)

### Initial Accreditation Date: 12/01/2005

| IHLAP Scope Category | Field of Testing (FOT) | Technology sub-type/Detector | Published Reference Method/Title of In-house Method | Component, parameter or characteristic tested |
|---|---|---|---|---|
| Asbestos/Fiber Microscopy Core | Phase Contrast Microscopy (PCM) | - | NIOSH 7400 | Asbestos/Fibers |
| Chromatography Core | GC/MS | - | EPA TO-15 | Volatile Organic Compounds |
| Chromatography Core | Gas Chromatography | GC/ECD | NIOSH 5503 | PCB's |
| Chromatography Core | Gas Chromatography | GC/FID | NIOSH 1003 | Halogenated Hydrocarbons |
| Chromatography Core | Gas Chromatography | GC/FID | NIOSH 1400 | Alcohols |
| Chromatography Core | Gas Chromatography | GC/FID | NIOSH 1501 | Aromatic Hydrocarbons |
| Chromatography Core | Gas Chromatography | GC/FID | NIOSH 2000 | Methanol |
| Chromatography Core | Ion Chromatography (IC) | - | OSHA ID-215 (Version 2) | Hexavalent Chromium |
| Chromatography Core | Liquid Chromatography | HPLC/UV | NIOSH 2016 | Formaldehyde |
| Miscellaneous Core | Gravimetric | - | NIOSH 0500 | Total Dust |
| Miscellaneous Core | Gravimetric | - | NIOSH 0600 | Respirable Dust |
| Spectrometry Core | Atomic Absorption | CVAA | NIOSH 6009 | Mercury |
| Spectrometry Core | Atomic Absorption | CVAA | OSHA ID-140 | Mercury |
| Spectrometry Core | Atomic Absorption | CVAA | OSHA ID-145 | Mercury |
| Spectrometry Core | Inductively-Coupled Plasma | ICP/MS | NIOSH 7300 | Metals |
| Spectrometry Core | Inductively-Coupled Plasma | ICP/MS | NIOSH 7303 | Metals |
| Spectrometry Core | Inductively-Coupled Plasma | ICP/OES | NIOSH 7300 | Metals |
| Spectrometry Core | Inductively-Coupled Plasma | ICP/OES | NIOSH 7303 | Metals |

| IHLAP Scope Category | Field of Testing (FOT) | Technology sub-type/Detector | Published Reference Method/Title of In-house Method | Component, parameter or characteristic tested |
|---|---|---|---|---|
| Spectrometry Core | X-ray Diffraction (XRD) | - | NIOSH 7500 | Silica |
| Spectrometry Core | X-ray Diffraction (XRD) | - | OSHA ID-142 | Silica |

A complete listing of currently accredited IHLAP laboratories is available on the AIHA-LAP, LLC website at: *http://www.aihaaccreditedlabs.org*

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Omaha District