
**REQUEST FOR PROPOSAL
(FOR CONSTRUCTION CONTRACT)
DIVISIONS 01 - 33
SOLICITATION NO. W9128F22R0017**

**JOINT CRYPTOLOGIC CENTER (JCC)
BUILDING
PNPTN 40171 (FY22)**

BUCKLEY SFB, COLORADO

DECEMBER 2022



**US Army Corps
of Engineers®**
Omaha District

This page was intentionally left blank for duplex printing.

SECTION 00 01 07

SEALS PAGE
02/15

PART 1 SUMMARY

1.1 SEALS AND SIGNATURES

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed Professional Architect under the laws of the State of New York.

License No. 037114-01.

Expiration Date: 02/28/2023.



Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed Professional Engineer under the laws of the Commonwealth of Virginia.

License No. 060478.

Expiration Date: 03/31/2023.



Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed Registered Interior Designer under the laws of the State of Texas.

License No. 11851.

Expiration Date: 10/31/2023.



Joint Cryptologic Center (JCC) Building Expansion
Buckley SFB, Colorado

19 December 2022
RTA Submission

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed Professional Engineer under the laws of the Commonwealth of Virginia.

License No. 040226777.

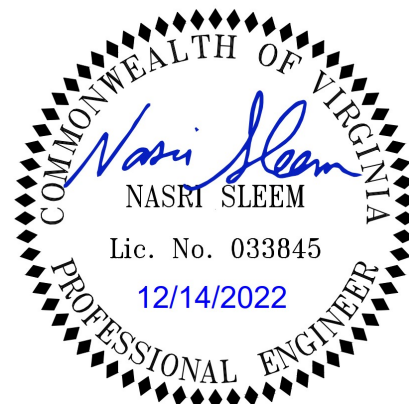
Expiration Date: 01/31/2024.



Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed Professional Engineer under the laws of the Commonwealth of Virginia.

License No. 0402033845.

Expiration Date: 01/31/2023.



Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed Professional Engineer under the laws of the Commonwealth of Virginia.

License No. 0402047869.

Expiration Date: 06/30/2023.



Joint Cryptologic Center (JCC) Building Expansion
Buckley SFB, Colorado

19 December 2022
RTA Submission

Professional Certification. I hereby
certify that these documents were prepared or
approved by me, and that I am a duly licensed
Registered Communications Distribution Designer.

License No. 128496.

Expiration Date: 12/31/2023.



Professional Certification. I hereby
certify that these documents were prepared or
approved by me, and that I am a duly licensed
Registered Communications Distribution Designer.

License No. 219192.

Expiration Date: 12/31/2022.



Professional Certification. I hereby
certify that these documents were prepared or
approved by me, and that I am a duly licensed
Professional Engineer under the laws
of the Commonwealth of Virginia.

License No. 035184.

Expiration Date: 03/31/2024.



-- End of Section --

This page was intentionally left blank for duplex printing.

**SPECIFICATIONS FOR CONSTRUCTION
JOINT CRYPTOLOGIC CENTER (JCC)
BUILDING
PNPTN 40171 (FY22)
BUCKLEY SFB, CO**

PROJECT TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

01 14 00	WORK RESTRICTIONS
01 14 00AT1	ICD TECH SPEC – FOR ICD/ICS 705, VERSION 1.5 DATED MAR 2020
01 14 00AT2	DD FORM 127 - REQUEST FOR UNESCORTED VISITOR ACCESS (UP TO 1 YEAR)
01 14 00AT3	DD FORM 127 - REQUEST FOR UNESCORTED VISITOR ACCESS (UP TO 1 YEAR, 24-7 ACCESS)
01 14 00AT4	DD FORM 128 – REQUEST FOR UNESCORTED VISITOR ACCESS (TEMP, UP TO 30 DAYS)
01 30 00.24	OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS
PROJSIGN	PROJECT SIGN DETAILS
AF103	AF103 - BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST
01 32 01.00 10	PROJECT SCHEDULE
01 33 00	SUBMITTAL PROCEDURES
REGISTER	PROJECT SUBMITTAL REGISTER
E4025	ENG FORM 4025 TRANSMITTAL FORM
01 33 29	SUSTAINABILITY REQUIREMENTS AND REPORTING
01 33 29AT1	AF SUSTAINABILITY SCORESHEET
01 33 29AT2	GUIDING PRINCIPLES ASSESSMENT DOD PROJECT INFORMATION FORM
01 33 39.00 10	ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS
01 35 26	GOVERNMENTAL SAFETY REQUIREMENTS
01 35 29.13	HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES
01 41 26.05 24	(FEDERAL FACILITIES COLORADO) NPDES PERMIT REQUIREMENTS FOR STORM WATER DISCHARGES FROM CONSTRUCTION SITES
01 45 00.00 10	QUALITY CONTROL
01 45 00.00 10AT	SAMPLE QUALITY CONTROL REPORT
01 45 00.15 10	RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM)
01 45 35	SPECIAL INSPECTIONS
01 45 35AT1	SCHEDULE OF SPECIAL INSPECTIONS
01 45 35AT2	STATEMENT OF SPECIAL INSPECTIONS
01 57 20.00 10	ENVIRONMENTAL PROTECTION
01 57 23.00 10	STORM WATER POLLUTION PREVENTION MEASURES
01 62 35	RECYCLED / RECOVERED MATERIALS
01 74 19	CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
01 78 23	OPERATION AND MAINTENANCE DATA
01 78 24.00 10	FACILITY DATA REQUIREMENTS
01 78 36.00 24	WARRANTY OF CONSTRUCTION
01 78 39.00 24	AS-BUILT DRAWINGS
01 78 39.00 24AT1	MODIFICATIONS AND TITLE BLOCK EXAMPLES
01 78 39.00 24AT	BUCKLEY AFB CAD, DRAWINGS, ASBUILT, AND SURVEY STANDARD
01 91 00.15 10	TOTAL BUILDING COMMISSIONING

DIVISION 02 - EXISTING CONDITIONS

02 41 00	DEMOLITION
----------	------------

DIVISION 03 - CONCRETE

03 30 00	CAST-IN-PLACE CONCRETE
----------	------------------------

DIVISION 04 - MASONRY

04 20 00 UNIT MASONRY

DIVISION 05 - METALS

05 12 00 STRUCTURAL STEEL
 05 30 00 STEEL DECKS
 05 40 00 COLD-FORMED METAL FRAMING
 05 50 13 MISCELLANEOUS METAL FABRICATIONS
 05 51 00 METAL STAIRS
 05 51 33 METAL LADDERS
 05 52 00 METAL RAILINGS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 10 00 ROUGH CARPENTRY
 06 41 16.00 10 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS
 06 61 16 SOLID SURFACING FABRICATIONS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS
 07 13 53 ELASTOMERIC SHEET WATERPROOFING
 07 21 13 BOARD AND BLOCK INSULATION
 07 21 16 MINERAL FIBER BLANKET INSULATION
 07 22 00 ROOF AND DECK INSULATION
 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM
 07 27 19.01 SELF-ADHERING AIR BARRIERS
 07 27 26 FLUID-APPLIED MEMBRANE AIR BARRIERS
 07 54 23 THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING
 07 60 00 FLASHING AND SHEET METAL
 07 81 00 SPRAY-APPLIED FIREPROOFING
 07 84 00 FIRESTOPPING
 07 92 00 JOINT SEALANTS

DIVISION 08 - OPENINGS

08 11 13 STEEL DOORS AND FRAMES
 08 11 16 ALUMINUM DOORS AND FRAMES
 08 14 00 WOOD DOORS
 08 31 00 ACCESS DOORS AND PANELS
 08 34 73 SOUND CONTROL DOOR ASSEMBLIES
 08 41 13 ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS
 08 44 00 CURTAIN WALL AND GLAZED ASSEMBLIES
 08 71 00 DOOR HARDWARE
 08 71 00AT1 DOOR HARDWARE SETS
 08 81 00 GLAZING
 08 91 00 METAL WALL AND DOOR LOUVERS

DIVISION 09 - FINISHES

09 22 00 SUPPORTS FOR PLASTER AND GYPSUM BOARD
 09 29 00 GYPSUM BOARD
 09 30 10 CERAMIC, QUARRY, AND GLASS TILING
 09 51 00 ACOUSTICAL CIELINGS
 09 62 38 STATIC-CONTROL FLOORING
 09 65 00 RESILIENT FLOORING
 09 68 00 CARPETING
 09 84 20 ACOUSTICAL WALL PANELS
 09 90 00 PAINTS AND COATINGS

DIVISION 10 - SPECIALTIES

10 14 00.10	EXTERIOR SIGNAGE
10 14 00.20	INTERIOR SIGNAGE
10 21 13	TOILET COMPARTMENTS
10 21 23.16	CUBICLE TRACK AND HARDWARE
10 22 39	FOLDING PANEL PARTITIONS
10 26 00	WALL AND DOOR PROTECTION
10 28 13	TOILET ACCESSORIES
10 44 16	FIRE EXTINGUISHERS
10 51 13	METAL LOCKERS

DIVISION 12 - FURNISHINGS

12 24 13	ROLLER WINDOW SHADES
12 50 00.13 10	FURNITURE AND FURNITURE INSTALLATION
12 59 00	SYSTEMS FURNITURE

DIVISION 14 - CONVEYING EQUIPMENT

14 24 23	HYDRAULIC PASSENGER ELEVATORS
----------	-------------------------------

DIVISION 21 - FIRE SUPPRESSION

21 13 13	WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION
----------	---

DIVISION 22 - PLUMBING

22 00 00	PLUMBING, GENERAL PURPOSE
----------	---------------------------

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

23 05 15	COMMON PIPING FOR HVAC
23 05 48.19	BRACING FOR HVAC
23 05 93	TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 07 00	THERMAL INSULATION FOR MECHANICAL SYSTEMS
23 09 00	INSTRUMENTATION AND CONTROL FOR HVAC
23 09 13	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
23 09 23.02	BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS
23 11 20	FACILITY GAS PIPING
23 21 23	HYDRONIC PUMPS
23 23 00	REFRIGERANT PIPING
23 25 00	CHEMICAL TREATMENT OF WATER FOR MECHANICAL SYSTEMS
23 30 00	HVAC AIR DISTRIBUTION
23 52 00	HEATING BOILERS, TERMINAL HEATING UNITS AND GLYCOL FEEDER
23 81 00	DECENTRALIZED UNITARY HVAC EQUIPMENT
23 81 23	COMPUTER ROOM AIR CONDITIONING UNITS

DIVISION 25 - INTEGRATED AUTOMATION

25 05 11.21	CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS FIRE AND LIFE SAFETY SYSTEMS
25 05 11.23	CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM
25 05 11.28	CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS – ELECTRONIC SECURITY SYSTEMS
25 10 10	UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION

DIVISION 26 - ELECTRICAL

26 08 00	APPARATUS INSPECTION AND TESTING
26 12 19.10	THREE-PHASE, LIQUID-FILLED PAD-MOUNTED TRANSFORMERS

DIVISION 26 – ELECTRICAL (CONTINUED)

26 20 00	INTERIOR DISTRIBUTION SYSTEM
26 24 13	SWITCHBOARDS
26 27 13.10 30	ELECTRIC METERS
26 28 01.00 10	COORDINATED POWER SYSTEM PROTECTION
26 29 23	ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS
26 41 00	LIGHTNING PROTECTION SYSTEM
26 42 13	GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM
26 51 00	INTERIOR LIGHTING
26 56 00	EXTERIOR LIGHTING

DIVISION 27 - COMMUNICATIONS

27 10 00	BUILDING TELECOMMUNICATIONS CABLING SYSTEM
----------	--

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 08 10	ELECTRONIC SECURITY SYSTEM ACCEPTANCE TESTING
28 10 05	ELECTRONIC SECURITY SYSTEMS (ESS)
28 31 76	INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE

DIVISION 31 - EARTHWORK

31 00 00	EARTHWORK
31 00 00AT1	BAFB SPECIFIC REGULATED ASBESTOS CONTAMINATED SOIL MANAGEMENT PLAN
31 63 29	DRILLED CONCRETE PIERS AND SHAFTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 05 33	LANDSCAPE ESTABLISHMENT
32 11 23	AGGREGATE BASE COURSES
32 12 16.16	ROAD-MIX ASPHALT PAVING
32 16 19	CONCRETE CURBS, GUTTERS AND SIDEWALKS
32 17 23	PAVEMENT MARKINGS
32 92 19	SEEDING
32 93 00	EXTERIOR PLANTS

DIVISION 33 - UTILITIES

33 11 00	WATER UTILITY DISTRIBUTION PIPING
33 30 00	SANITARY SEWERAGE
33 40 00	STORM DRAINAGE UTILITIES
33 51 15	NATURAL-GAS DISTRIBUTION PIPELINES
33 71 02	UNDERGROUND ELECTRICAL DISTRIBUTION
33 82 00	TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

-- End of Project Table of Contents --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 14 00

WORK RESTRICTIONS

11/11

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Secure Area(s)
 - 1.2.2 Construction Secure Area Perimeter
 - 1.2.2.1 CSP and Construction Secure Area Implementation
 - 1.2.3 Security and Site Access Management Plan (SSAMP)
- 1.3 SUBMITTALS
- 1.4 PROJECT SECURITY AND SITE ACCESS MANAGEMENT PLAN (SSAMP)
- 1.5 ORDER OF WORK RESTRICTIONS
 - 1.5.1 Desire for Innovation
- 1.6 DOCUMENT CONTROL
- 1.7 BASE ACCESS AND SECURITY
 - 1.7.1 General
 - 1.7.2 Contractor Access
 - 1.7.3 Scheduled and Unscheduled No Work Days
 - 1.7.3.1 Operational Delays
 - 1.7.3.2 Right to Deny Entry
 - 1.7.4 Activity Regulations
 - 1.7.4.1 Subcontractors and Personnel Contacts
 - 1.7.4.2 No Smoking Policy
 - 1.7.5 Contractor Vehicles
- 1.8 ACCESS AND SECURITY ROLES AND RESPONSIBILITIES
 - 1.8.1 Worksite and Secure Area Perimeter
 - 1.8.1.1 Contractor Responsibilities
 - 1.8.1.2 Government Responsibilities
- 1.9 Information Access
- 1.10 Government Project Inspector
- 1.11 Communications Security (COMSEC) Monitoring

PART 2 PRODUCTS

PART 3 EXECUTION

ATTACHMENTS:

- 1. IC Tech Spec - for ICD/ICS 705 (Version 1.5, dated March 2020)
- 2. DD Form 127 - Request for Unescorted Visitor Access (up to 1 year)
- 3. DD Form 127 - Request for Unescorted Visitor Access (up to 1 year, 24-7 access)

4. DD Form 128 - Request for Unescorted Visitor Access (temp, up to 30 days)

-- End of Section Table of Contents --

SECTION 01 14 00

WORK RESTRICTIONS

11/11

PART 1 GENERAL

1.1 REFERENCES

The design publications listed below shall be used as sources of criteria for construction of the project. The most current edition of the code or standard (with errata and addenda) available at bid 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. DEPARTMENT OF DEFENSE (DOD)

DODM 5200.01	(Volumes 1-3) DoD Information Security Program.
UFC 4-010-05	Sensitive Compartmented Information Facilities Planning, Design, and Construction, with changes, dated 1 February 2013

1.2 DEFINITIONS

1.2.1 Secure Area(s)

Areas identified in the design documents as "secure area" 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. The most current version of this specification is attached to this specification.

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.

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 Site Security Officer (SSO) and Site Security Manager (SSM) assign layers of oversight for purposes of Construction Security Plan (CSP) implementation in compliance with ICD/ICS 705. This perimeter is established by a site perimeter fence (in this case, the primary site fence described below and in the design drawings) early in construction and prior to the construction of the physical, permanent secure area boundary as defined by the built facility perimeter. Once the permanent secure area boundary is 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 from non-secure area construction within the facility for more effective secure area oversight. Coordinate the perimeter(s) and transitions from one CSP implementation perimeter to another with the SSM and with the anticipated order of construction, through the duration of the project. When work is not ongoing (or no onsite presence by the Prime Contractor), the entry gate to the perimeter fence shall be secured with a keyed padlock(s) or similar locking mechanism.

1.2.2.1 CSP and Construction Secure Area Implementation

CSP implementation will occur on the project once the SSAMP is approved, the project site is cleared, the secure site perimeter fence is constructed and approved by the SSM, and once the proposed facility foundations are laid. CSP implementation will occur from that point through the entire duration of construction to include procurement and installation of any bid options.

Contractor responsibilities associated with CSP implementation on this project will only terminate upon full Government acceptance of all work 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 responsibility to establish the order of work within the constraints established within this contract, no work on the vertical facility, other than placement of below-grade features and foundations, 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 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.

1.3 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

1.4 PROJECT SECURITY AND SITE ACCESS MANAGEMENT PLAN (SSAMP)

Prior to the start of construction, 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 documents. This shall include, but is not limited to, the following information. Clearly separate the plan into "Secure Area" work and non-"Secure Area" Work as defined above:

- 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 perimeter fence(s) with specs, dates, and durations. Indicate any anticipated changes to the fence(s) during the duration of the project.
- d. Anticipated dates and durations of various work activities that will require Government oversight per the requirements in this contract.
- e. Description of Contractor processes and procedures associated with Secure Area construction, Government oversight, accreditation, and associated security requirements.
- f. Anticipated procedures for Contractor site security and access management for each work activity.
- g. Anticipated vehicle and equipment list requiring access to restricted sites.
- h. Anticipated usage of gates, barricades, barriers and similar at secure area perimeters, etc.
- i. Material procurement shall be accomplished via standard procedures and materials purchased from U.S. based companies, ensuring compliance with Federal Acquisition Regulations, Part 25.
- j. Describe the technical approach to construction of the facility(ies).

Include considerations for management of both the "Secure Area" construction security (in accordance with UFC 4-010-05 and ICD/ICS 705) and DODM 5200.01.

The SSAMP shall be a living document that records the Contractor's approach for compliance with work restrictions documented herein. As Contractor requirements evolve, update the SSAMP for use 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. Permission to interrupt any roads, security fences/perimeters, paths, or utility service must be requested in accordance with requirements listed in 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.
- b. 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 base facilities in compliance with utility outage request requirements in 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

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

Distributed hardcopies of documents (including the design analysis, plans, and specifications) are marked Controlled Unclassified Information (CUI) and shall be stored within the project 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.

1.7 BASE ACCESS AND SECURITY

1.7.1 General

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.

1.7.2 Contractor Access

- a. Each Contractor and Contractor employee to work on the job at

Buckley must obtain a vehicle pass to enter the base. The pass will be obtained the first day of work at Buckley, or not later than the next working day. To obtain the vehicle pass, the vehicle operator must possess a current, valid driver's license, 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 the base. Employees who are terminated from employment will surrender any and all identification media and vehicle passes to their immediate supervisor, who will in turn surrender same to the Pass and ID Office, and the supervisor will immediately escort the terminated employee off base, and notify Base Police of the termination. Access to Buckley SFB shall be through the Mississippi Avenue Gate. The Contractor shall provide the Buckley SFB Base Security Police a copy of a completed "Contractor Employee Verification List" Attachment, which is to include the names of all subcontractors and suppliers, and the names and social security numbers of all employees requiring access to the Base. The list shall be revised in its entirety and a new copy provided to the Buckley SFB Security Police as persons/companies are added and/or deleted.

b. All drivers on Buckley 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.

c. The Contractor's Superintendent must notify Base Police 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 Base Police, 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. Any work area found by Base Police to be unsecured 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, notify, through the Contracting Office, the Base Police of the blockage, prior to the blockage, and ensure that proper signs are provided by the contractor and installed to divert traffic around the affected area. As much lead time notification as possible is appreciated for proper coordination, and notification of other activities on base.

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 30 MPH, unless otherwise posted. The speed limit through the gates is 20 MPH. 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 Space Force Base, including Buckley SFB.

h. The new Large Vehicle Inspection Point (LVIP) will be the main contractor/commercial access point for any vehicle that is towing a trailer, does not have a badge, and for any deliveries. It will be closed on Federal Holidays and is only accessible during work hours (6:00 am to 6:00 pm), unless after hours procedures are followed. Contractor may also access the Base via the Main Gate from Mississippi Avenue or via the 6th Avenue Gate. Use of the 6th Avenue gate requires a badge.

i. 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.

j. Buckley SFB is considered to be a closed facility. No unauthorized tours or visitors will be allowed on the installation.

1.7.3 Scheduled and Unscheduled No Work Days

See Section 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.

1.7.3.1 Operational Delays

The Contractor and their personnel shall leave Buckley Space Force Base (BSFB) immediately and safely upon notification by the Contracting Officer (CO), the CO's 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

The Installation Commander or designated representative reserves the right to deny entry to any Contractor whose National Agency Check (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 BSFB 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 the denial of future entry to BSFB.

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 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.

1.7.5 Contractor Vehicles

All Contractor vehicle operators are required to obtain vehicle entry passes for any vehicles operating on BSFB at the Visitor Center. The Contractor will be required to present proof of insurance, drivers license, vehicle registration, and other documentation as needed to obtain vehicle entry pass. Prominently display the company name on all vehicles operated on BSFB.

1.8 ACCESS AND SECURITY ROLES AND RESPONSIBILITIES

1.8.1 Worksite and Secure Area Perimeter

This project requires construction, and accreditation of a Secure Area as defined by ICD/ICS 705 and the design drawings and specifications. As such, Contractor shall ensure the facility is 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.

1.8.1.1 Contractor Responsibilities

- a. Inventory, track, and store secure area construction-related plans and documents. When not stored within the project fenced perimeter, provide GSA approved secure safe(s) for plans and document storage on site.
- b. Erect a secure chain link fence around the project site with a single securable access point, as indicated in the design drawings and specifications.
- c. Contractor will conduct initial vetting for workers using e-Verify to confirm all workers are US Citizens or Lawful Residents 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.

All work shall be completed by U.S. Citizens or Lawful Residents. All

workers onsite (Prime and Subcontractor) must be vetted through the MPO's Enterprise Threat Management Unit (A5125) beginning work on the project. Worker information required for this process includes:

Full Name
Date of birth
Place of birth
SSN
Fingerprinting

d. After successful validation of US Citizen or Lawful Resident 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.

e. All construction workers performing finish work and/or installing telecommunications infrastructure within the Secure Area will assure that they and their work are overseen at all times by Government-provided security technicians - unless specifically waived by the SSM.

f. Workers will enter the site through the site perimeter fence entry.

g. All construction equipment entering the site will be validated through 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.

i. 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 be stored inside the fenced construction perimeter.

j. Once general materials are selected for use in Secure Area construction, but are not immediately used as well as any materials/equipment that are ordered required specifically for the Secure Area arrive and are not immediately installed, they will be stored within the fenced construction perimeter or within the Secure Area. Sole control of access to these materials may retained by the SSM.

k. 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.

l. 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.

m. 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 secure area and CSP requirements. Do not store

equipment within 30 feet of the secure area or RA perimeter fence(s), unless specifically authorized in writing by the SSM and SFS.

1.8.1.2 Government Responsibilities

- a. Secure Area security oversight and vetting.
- b. Re-verification of contractor's vetting of employees as US Citizen or Lawful Resident status.
- c. If established, the Government is responsible for tracking and validating all access/vehicles/supplies into the secure area perimeter with oversight provided by the SSM or authorized (Government-provided) security technicians procured separately from this contract.
- d. If established, the Government is responsible for Secure Area construction inspection and approval.
- e. As required for inspection, the SSM will randomly select materials from general stock for use in construction of the Secure Area.
- f. The SSM will maintain all secure area access log information (visitors, workers, security events, access control logs, etc).

1.9 Information Access

Contractor access to classified information is prohibited.

1.10 Government Project Inspector

Government Project Inspector will be assigned to each project and will resolve all security issues/problems between the Contractor and Security Forces.

1.11 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.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Attachments:

1. IC Tech Spec - for ICD/ICS 705 (Version 1.5, dated March 2020)
2. DD Form 127 - Request for Unescorted Visitor Access (up to 1 year)

3. DD Form 127 - Request for Unescorted Visitor Access (up to 1 year, 24-7 access)
4. DD Form 128 - Request for Unescorted Visitor Access (temp, up to 30 days)

-- End of Section --

NATIONAL COUNTERINTELLIGENCE AND SECURITY CENTER

Advancing Counterintelligence and Security Excellence



Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities

VERSION 1.5

IC Tech Spec – for ICD/ICS 705

An Intelligence Community Technical Specification
Prepared by the
National Counterintelligence and Security Center

March 13, 2020

This page intentionally left blank.

OFFICE OF THE DIRECTOR OF NATIONAL INTELLIGENCE
DIRECTOR OF THE NATIONAL COUNTERINTELLIGENCE AND SECURITY CENTER
WASHINGTON, DC 20511

NCSC 19-686

MEMORANDUM FOR: Distribution


SUBJECT: Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.5

REFERENCES: A. (U) D/NCSC Memo NCSC-19-329, Technical Specifications for Construction and Management of Sensitive Compartmented Information Facilities, Version 1.4, 28 Sep 17 (U)
B. (U) Technical Specifications, Version 1.4, 28 Sep 17 (U)
C. (U) ICD 705, Sensitive Compartmented Information Facilities, 26 May 10 (U)
D. (U) ICS 705-01, Physical and Technical Standards for Sensitive Compartmented Information Facilities, 27 Sep 10 (U)
E. (U) ICS 705-02, Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities, 22 Dec 16 (U)

This memorandum promulgates Version 1.5 of the Technical Specification for Construction and Management of Sensitive Compartmented Information Facilities to the Intelligence Community, which replaces Version 1.4 (Ref A), effective immediately.

The Technical Specifications was designed to be a living document that enables periodic updates to keep up with changing and emerging technology. Based on input from the Intelligence Community (IC) and as a result of a cooperative effort by physical and technical experts from IC elements and our industrial partners, this Version 1.5 of the Technical Specifications has been updated to meet the needs of the community and enhance the standards identified in ICS 705-01, Physical Security Standards for Sensitive Compartmented Information Facilities (Ref C) and ICS 705-02, Standards for the Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities (Ref D).

Questions may be directed to the National Counterintelligence and Security Center's Special Security Directorate at DNI-NCSC-SSD-CSG-PTSP-Mailbox@cia.ic.gov.


William R. Evanina

3-13-20
Date

SUBJECT: Technical Specifications for Construction and Management of Sensitive
Compartmented Information Facilities, Version 1.5

Distribution:

Secretary of State, Department of State
Secretary of the Treasury, Department of the Treasury
Secretary of Defense, Department of Defense
Attorney General, Department of Justice
Secretary of the Interior, Department of the Interior
Secretary of Agriculture, Department of Agriculture
Secretary of Commerce, Department of Commerce
Secretary of Labor, Department of Labor
Secretary of Health and Human Services, Department of Health and Human Services
Secretary of Housing and Urban Development, Department of Housing and Urban
Development
Secretary of Transportation, Department of Transportation
Secretary of Energy, Department of Energy
Secretary of Education, Department of Education
Secretary of Veterans Affairs, Department of Veterans Affairs
Secretary of Homeland Security, Department of Homeland Security
Administrator, Executive Office of the President
Administrator, Environmental Protection Agency
Director, Office of Management and Budget
United States Trade Representative
Administrator, Small Business Administration
Director, National Drug Control Policy
Director, Central Intelligence Agency
Administrator, Equal Employment Opportunity Commission
Chairman, Federal Communications Commission
Chairman, Federal Maritime Commission
Chairman, Federal Reserve System
Chairman, Federal Trade Commission
Administrator, General Services Administration
Administrator, National Aeronautics and Space Administration
Archivist, National Archives and Records Administration
Director, National Science Foundation
Chairman, Nuclear Regulatory Commission
Director, Office of Government Ethics
Chairman, Privacy and Civil Liberties Oversight Board
Chairman, Security and Exchange Commission
Director, Selective Service System
Commissioner, Social Security Administration
Administrator, United States Agency for International Development
United States Postal Service
Chairman, United States International Trade Commission
Director, United States Peace Corps

SUBJECT: Technical Specifications for Construction and Management of Sensitive
Compartmented Information Facilities, Version 1.5

Distribution, cont.:

Office of the Chief Administrative Officer

Change History

Rev. #	Date	Page	Changes	Approver
1.2	04/23/12	Cover	Banner Graphic, Version, Date	PTSEWG
1.2	04/23/12	4	Added note to warn users of classification when associating threat information and facility location.	PTSEWG
1.2	04/23/12	5	Re-worded approval of CAs to designate the AO as the primary approval authority of Compartmented Areas within SCIFs.	PTSEWG
1.2	04/23/12	9-10	Changed “Type X Gypsum” to “wallboard” to remove the standard of fire resistant gypsum and permit use of other wallboard types.	PTSEWG
1.2	04/23/12	9-10	Changed references to wall design drawings to “suggested” wall types to enable variety of wall construction techniques to meet the security standards.	PTSEWG
1.2	04/23/12	10	Added explanation to glue and screw plywood to ceiling and floor to clarify standard. Stud placement changed to 16 on center to match drawing and correct error.	PTSEWG
1.2	04/23/12	11	Added statement to finish wall and paint from true floor to true ceiling in Walls B and C to clarify and equal Type A Wall.	PTSEWG
1.2	04/23/12	9-10	Replaced drawings to reflect “suggested” wall construction methods and remove references to “Type X gypsum wallboard”.	PTSEWG
1.2	04/23/12	17-19	Replaced drawings to reflect “suggested” wall construction methods and remove references to “Type X gypsum wallboard”.	PTSEWG
1.2	04/23/12	56	Updated Federal Information Processing Standards (FIPS) encryption standards and certification to remove a standard that could not be met by commercial alarm systems.	PTSEWG
1.2	04/23/12	64	Replaced FIPS 140-2 with Advanced Encryption Standard (AES) to remove a standard that could not be met by commercial alarm systems.	PTSEWG

Rev. #	Date	Page	Changes	Approver
1.2	04/23/12	TEMPEST Checklist	Removed references to “inspectable space” as requested by the TEMPEST Advisory Group (TAG).	PTSEWG
1.2	04/23/12	TEMPEST Checklist	Removed references to “Red-SCI” information.	PTSEWG
1.2	04/23/12	TEMPEST Checklist	Removed parenthetical reference to cell phones and Bluetooth.	PTSEWG
1.2	04/23/12	CA Checklist	Replaced Compartmented Area Checklist to reflect IC standards.	PTSEWG
1.2	04/23/12	SCIF Co-Use Request and MOA Form	Replaced Co-Use and MOA Form to include “joint-use” statements.	PTSEWG
1.3	03/26/15	Cover	Banner change, version, date	PTSEWG
1.3	03/26/15	B-C	Appended “D/NCSC Memorandum”	PTSEWG
1.3	03/26/15	D-G	“Appended Change History”	PTSEWG
1.3	03/26/15	3	Chapter 2.A (2)(a) Added: “NOTE” regarding prefabricated modular SCIFs.	PTSEWG
1.3	03/26/15	9	Chapter 3.C Corrected wording to match wall drawings on p.21.	PTSEWG
1.3	03/26/15	14	Chapter 3.G (7)(c.4) Correction and addition of guidance on vents and ducts perimeter protection.	PTSEWG
1.3	03/26/15	17-19	Reformatted wall types to reflect correct architectural graphics for prescribed materials.	PTSEWG
1.3	03/26/15	53	Chapter 7.A (2)(d) Added requirement for HSS switches.	PTSEWG
1.3	03/26/15	54	Chapter 7.A (2)(k) Changed to reflect restrictions on dissemination of installation plans.	PTSEWG
1.3	03/26/15	54	Chapter 7.A (3)(a.2) Added exception that sensors must be located within SCIF perimeter.	PTSEWG
1.3	03/26/15	55	Chapter 7.A (3)(b.7.e) Replaced “Zones” with “IDE sensor points”.	PTSEWG
1.3	03/26/15	56	Chapter 7.A (3)(c.1) Added language for approval authority.	PTSEWG
1.3	03/26/15	56	Chapter 7.A (3)(c.2) Added language for integrated IDS and Remote Access.	PTSEWG
1.3	03/26/15	56-57	Chapter 7.A (3)(c.2) Added system application software requirements.	PTSEWG
1.3	03/26/15	58-59	Replaced “access/secure” with “arm/disarm” throughout.	PTSEWG

Rev. #	Date	Page	Changes	Approver
1.3	03/26/15	58	Chapter 7.B (2) Added “A record shall be maintained that identifies the person responsible for disarming the system”.	PTSEWG
1.3	03/26/15	87	Chapter 12.G (2) Changed Section header to read “Inspections/Reviews, added same where the term “inspection” or “review” used. The responsibility to perform as such was changed from “IC element head” to the AO, or designee.	PTSEWG
1.3	03/26/15	SCIF Co-Use Request and MOA Form	Appended Co-Use Request and MOA Form	PTSEWG
1.4	06/27/17	Cover	Banner change, version, date	PTSEWG
1.4	06/27/17	i-iii	Appended “D/NCSC Memorandum”	PTSEWG
1.4	06/27/17	iv-vii	“Appended Change History”	PTSEWG
1.4	06/27/17	1	Chapter 1.B.2 Added SAPF Language	PTSEWG
1.4	06/27/17	12	Chapter 3.E.1.b Added egress device language	PTSEWG
1.4	06/27/17	60	Chapter 7.C.1.c Added, “...IAW UL 2050 requirements (60 minutes)”	PTSEWG
1.4	06/27/17	71-74	Chapter 10 Revised	PTSEWG
1.4	06/27/17	75-76	Chapter 11.B.5 Added sub-bullets to address CNSSI 5002	PTSEWG
1.4	06/27/17	90-91	Chapter 12.L1/2/7 Added clarification language	PTSEWG
1.4	06/27/17	91-92	Chapter 12.M.4 Synchronized bullets	PTSEWG
1.5	11/13/19	3-4	Chapter 2.A.3.a Added clarification language	PTSEWG
1.5	11/13/19	5-6	Chapter 2.C.2 Defined CA Types	PTSEWG
1.5	11/13/19	8	Chapter 3. Added Pre-Construction Checklist language	PTSEWG
1.5	11/13/19	13-15	Chapter 3.E Expanded SCIF Door Criteria	PTSEWG
1.5	11/13/19	30	Chapter 4.E.2 Added reference to Inspectable Materials Checklist	PTSEWG

1.5	11/13/19	35	Chapter 5.A Added language in Applicability	PTSEWG
1.5	11/13/19	46	Chapter 6.A.1.a Added exception language	PTSEWG
1.5	11/13/19	74-77	Chapter 10 Changed “CSA” to “AO” where appropriate	PTSEWG
1.5	11/13/19	90	Chapter 12.G.8 Added TSCM language to Inspections/Reviews	PTSEWG
1.5	11/13/19	95-97	Chapter 12.N/O/P Added CUA instructions	PTSEWG
1.5	11/13/19	98	Chapter 13 Updated FFC and added CUA Guide and Cancellation Forms, Inspectable Materials Checklist, Pre-Construction Checklist	PTSEWG

This page intentionally left blank.

Table of Contents

Chapter 1. Introduction.....	1
A. Purpose.....	1
B. Applicability.....	1
Chapter 2. Risk Management.....	3
A. Analytical Risk Management Process.....	3
B. Security in Depth (SID).....	4
C. Compartmented Area (CA)	5
Chapter 3. Fixed Facility SCIF Construction.....	8
A. Personnel.....	8
B. Construction Security.....	9
C. Perimeter Wall Construction Criteria.....	10
D. Floor and Ceiling Construction Criteria.....	13
E. SCIF Door Criteria.....	13
F. SCIF Window Criteria.....	15
G. SCIF Perimeter Penetrations Criteria.....	15
H. Alarm Response Time Criteria for SCIFs within the U.S.	17
I. Secure Working Areas (SWA)	17
J. Temporary Secure Working Area (TSWA)	18
Chapter 4. SCIFs Outside the U.S. and NOT Under Chief of Mission (COM) Authority.....	23
A. General.....	23
B. Establishing Construction Criteria Using Threat Ratings.....	23
C. Personnel.....	26
D. Construction Security Requirements.....	27
E. Procurement of Construction Materials.....	30
F. Secure Transportation for Construction Material.....	31
G. Secure Storage of Construction Material.....	32
H. Technical Security.....	33
I. Interim Accreditations.....	33
Chapter 5. SCIFs Outside the U.S. and Under Chief of Mission Authority.....	35
A. Applicability.....	35
B. General Guidelines.....	35
C. Threat Categories.....	36
D. Construction Requirements.....	36
E. Personnel.....	38
F. Construction Security Requirements.....	39
G. Procurement of Construction Materials.....	42
H. Secure Transportation for Construction Material.....	43
I. Secure Storage of Construction Material.....	44

J. Technical Security.....	44
K. Interim Accreditations.....	45
Chapter 6. Temporary, Airborne, and Shipboard SCIFs.....	46
A. Applicability.....	46
B. Ground-Based T-SCIFs.....	46
C. Permanent and Tactical SCIFS Aboard Aircraft.....	48
D. Permanent and Tactical SCIFs on Surface or Subsurface Vessels.....	50
Chapter 7. Intrusion Detection Systems (IDS)	56
A. Specifications and Implementation Requirements.....	56
B. IDS Modes of Operation.....	61
C. Operations and Maintenance of IDS.....	63
D. Installation and Testing of IDS.....	64
Chapter 8. Access Control Systems (ACS)	66
A. SCIF Access Control.....	66
B. ACS Administration.....	67
C. ACS Physical Protection.....	67
D. ACS Recordkeeping.....	67
E. Using Closed Circuit Television (CCTV) to Supplement ACS.....	68
F. Non-Automated Access Control.....	68
Chapter 9. Acoustic Protection.....	70
A. Overview.....	70
B. Sound Group Ratings.....	70
C. Acoustic Testing.....	70
D. Construction Guidance for Acoustic Protection.....	71
E. Sound Transmission Mitigations.....	71
Chapter 10. Portable Electronic Devices with Recording Capabilities and Embedded Technologies (PEDs/RCET).....	74
A. Approved Use of PEDs/RECET in a SCIF.....	74
B. Prohibitions.....	75
C. PED/RCET Risk Levels.....	75
D. Risk Mitigation.....	76
Chapter 11. Telecommunications Systems.....	78
A. Applicability.....	78
B. Unclassified Telephone Systems.....	78
C. Unclassified Information Systems.....	80
D. Using Closed Circuit Television (CCTV) to Monitor the SCIF Entry Point(s)	80
E. Unclassified Wireless Network Technology.....	80
F. Environmental Infrastructure Systems.....	81
G. Emergency Notification Systems.....	81

H. System Access.....	82
I. Unclassified Cable Control.....	82
J. Protected Distribution Systems.....	83
K. References.....	83
Chapter 12. Management and Operations.....	86
A. Purpose.....	86
B. SCIF Repository.....	86
C. SCIF Management.....	87
D. SOPs.....	88
E. Changes in Security and Accreditation.....	89
F. General.....	89
G. Inspections/Reviews.....	90
H. Control of Combinations.....	90
I. De-Accreditation Guidelines.....	91
J. Visitor Access.....	91
K. Maintenance.....	93
L. IDS and ACS Documentation Requirements.....	93
M. Emergency Plan.....	94
N. SCIF Co-Use and Joint Use.....	95
O. CUA Form and Instructions.....	96
P. CUA Cancellation.....	97
Chapter 13. Forms and Plans.....	98
Fixed Facility Checklist	
TEMPEST Checklist	
Compartmented Area Checklist	
Shipboard Checklist	
Submarine Checklist	
Aircraft/UAV Checklist	
SCIF Co-Use/Joint-Use Request	
SCIF Co-Use/Joint-Use Request Users Guide	
Cancellation of SCIF Co-Use/Joint-Use	
Pre-Construction Checklist	
Construction Security Plan (CSP)	
Inspectable Materials Checklist	

This page intentionally left blank.

Chapter 1. Introduction

A. Purpose

This Intelligence Community (IC) Technical Specification sets forth the physical and technical security specifications and best practices for meeting standards of Intelligence Community Standard (ICS) 705-01 (Physical and Technical Standards for Sensitive Compartmented Information Facilities). When the technical specifications herein are applied to new construction and renovations of Sensitive Compartmented Information Facilities (SCIFs), they shall satisfy the standards outlined in ICS 705-01 to enable uniform and reciprocal use across all IC elements and to assure information sharing to the greatest extent possible. This document is the implementing specification for Intelligence Community Directive (ICD) 705 (Sensitive Compartmented Information Facilities), ICS 705-01, and ICS 705-02 (Standards for Accreditation and Reciprocal Use of Sensitive Compartmented Information Facilities).

The specifications contained herein will facilitate the protection of Sensitive Compartmented Information (SCI) against compromising emanations, inadvertent observation and disclosure by unauthorized persons, and the detection of unauthorized entry.

B. Applicability

IC Elements shall fully implement this standard within 180 days of its signature.

1. SCIFs that have been de-accredited but controlled at the SECRET level (IAW 32 Code of Federal Regulations (CFR) parts 2001 and 2004) for less than one year may be re-accredited. The IC SCIF repository shall indicate that the accreditation was based upon the previous standards.
2. When the technical specifications herein have been applied to new construction, renovations, and operation of Special Access Program Facilities (SAPFs), those facilities shall satisfy the standards outlined in ICD 705 to enable uniform use across all IC elements for accreditation by IC elements as a Sensitive Compartmented Information Facility.
 - a) Accreditation of a SAPF as a SCIF will be based upon a review of all required SCIF construction documentation to ensure all ICD 705 requirements were met in the construction, maintenance, and operation of the SAPF.
 - b) The Accrediting Official (AO) will conduct a review of all SAPF accreditation documentation for compliance with the technical specifications herein.
 - (1) If all required documentation is available and correct, the AO will issue SCIF accreditation.
 - (2) If all required documentation is not available and correct, or waivers have been authorized, the AO is not required to issue SCIF accreditation.

- c) If the facility is to be maintained as a SAPF and co-utilized as a SCIF, the security posture of the facility will be to the highest requirement of the two.
 - (1) The AO may issue a more restrictive accreditation based upon the SCI requirements associated with the new SCIF accreditation. For example, 5 minute response versus 15 minutes, or Closed Storage versus Open Storage.
 - (2) Program indoctrination will be coordinated as part of the co-utilization agreement. Compartmented Areas may be utilized, but no other sub-division of the facility will be permitted. Facilities requiring additional protections are not suitable for co-utilization.

Chapter 2. Risk Management

A. Analytical Risk Management Process

1. The Accrediting Official (AO) and the Site Security Manager (SSM) should evaluate each proposed SCIF for threats, vulnerabilities, and assets to determine the most efficient countermeasures required for physical and technical security. In some cases, based upon that risk assessment, it may be determined that it is more practical or efficient to mitigate a standard. In other cases, it may be determined that additional security measures should be employed due to a significant risk factor.

2. Security begins when the initial requirement for a SCIF is known. To ensure the integrity of the construction and final accreditation, security plans should be coordinated with the AO before construction plans are designed, materials ordered, or contracts let.

a) Security standards shall apply to all proposed SCI facilities and shall be coordinated with the AO for guidance and approval. Location of facility construction and or fabrication does not exclude a facility from security standards and or review and approval by the AO. SCI facilities include but are not limited to fixed facilities, mobile platforms, prefabricated structures, containers, modular applications or other new or emerging applications and technologies that may meet performance standards for use in SCI facility construction.

NOTE: Advertised claims by manufactures that their product(s), to include mobile platforms, prefabricated structures, containers and modular structures are built to SCIF standards and can be accredited without modification may not be accurate. AOs are responsible for ensuring security controls spelled out in the ICD/ICS 705 series and this document are implemented to protect the security integrity of the proposed SCIF prior to accreditation.

b) Mitigations are verifiable, non-standard methods that shall be approved by the AO to effectively meet the physical/technical security protection level(s) of the standard. While most standards may be effectively mitigated via non-standard construction, additional security countermeasures and/or procedures, some standards are based upon tested and verified equipment (e.g., a combination lock meeting Federal Specification FF-L 2740) chosen because of special attributes and could not be mitigated with non-tested equipment. The AO's approval is documented to confirm that the mitigation is at least equal to the physical/technical security level of the standard.

c) Exceeding a standard, even when based upon risk, requires that a waiver be processed and approved in accordance with ICD 705.

3. The risk management process includes a critical evaluation of threats, vulnerability, and assets to determine the need and value of countermeasures. The process may include the following:

a) Threat Analysis. Assess the capabilities, intentions, and opportunity of an adversary to exploit or damage assets or information. For SCI Facilities under Chief of Mission (COM) authority or established on a permanent or temporary

basis within or on U.S. diplomatic facilities/compounds, use the Overseas Security Policy Board (OSPB), Security Environment Threat List (SETL) to determine technical threat to a location. When evaluating for TEMPEST, the Certified TEMPEST Technical Authorities (CTTA) shall use the National Security Agency Information Assurance (NSA IA) list as an additional resource for specific technical threat information. *NOTE: These threat documents are classified. Associating the threat level or other threat information with the SCIF location (including country, city, etc.) will normally carry the same classification level identified in the threat document. Ensure that SCIF planning documents and discussions that identify threat with the country or SCIF location are protected accordingly.* It is critical to identify other occupants of common and adjacent buildings. (However, do not attempt to collect information against U.S. persons in violation of Executive Order (EO) 12333.) In areas where there is a diplomatic presence of high and critical technical threat countries, additional countermeasures may be necessary.

- b) Vulnerability Analysis. Assess the inherent susceptibility to attack of a procedure, facility, information system, equipment, or policy.
- c) Probability Analysis. Assess the probability of an adverse action, incident, or attack occurring.
- d) Consequence Analysis. Assess the consequences of such an action (expressed as a measure of loss, such as cost in dollars, resources, programmatic effect/mission impact, etc.).

B. Security in Depth (SID)

1. SID describes the factors that enhance the probability of detection before actual penetration to the SCIF occurs. The existence of a layer or layers of security that offer mitigations for risks may be accepted by the AO. An important factor in determining risk is whether layers of security already exist at the facility. If applied, these layers may, with AO approval, alter construction requirements and extend security alarm response time to the maximum of 15 minutes. Complete documentation of any/all SID measures in place will assist in making risk decisions necessary to render a final standards decision.
2. SID is mandatory for SCIFs located outside the U.S. due to increased threat.
3. The primary means to achieve SID are listed below and are acceptable. SID requires that at least one of the following mitigations is applied:
 - a) Military installations, embassy compounds, U.S. Government (USG) compounds, or contractor compounds with a dedicated response force of U.S. persons.
 - b) Controlled buildings with separate building access controls, alarms, elevator controls, stairwell controls, etc., required to gain access to the buildings or elevators. These controls shall be fully coordinated with a formal agreement or managed by the entity that owns the SCIF.

- c) Controlled office areas adjacent to or surrounding SCIFs that are protected by alarm equipment installed in accordance with manufacturer's instructions. These controls shall be fully coordinated with a formal agreement or managed by the entity that owns the SCIF.
- d) Fenced compounds with access controlled vehicle gate and/or pedestrian gate.
- e) The AO may develop additional strategies to mitigate risk and increase probability of detection of unauthorized entry.

C. Compartmented Area (CA)

1. Definition

A CA is an area, room, or a set of rooms within a SCIF that provides controlled separation between control systems, compartments, sub-compartments, or Controlled Access Programs.

2. CA Types

- a) Type I CAs are intended for workstation environments that are used to view and process compartmented information. These areas may be comprised of open bays, open spaces, or a set of rooms with multiple cubicles in an accredited SCIF. Within these areas, compartmented information may be securely viewed and/or processed via an approved computer workstation by authorized personnel. Workstations in these environments may include computers with single or multiple monitors. When monitor positioning alone will not adequately protect the material from unauthorized viewing, i.e., shoulder surfing, polarized privacy screens shall be used. Compartmented data shall never be openly displayed on a monitor that faces a primary door or common work area. In addition to processing compartmented information on approved computer workstations, Type I CAs may also include the use of printers, copiers, and scanners if appropriate procedures for control of hard copy material have been established and approved by the AO. No storage or discussion is authorized, logical and/or physical.
- b) Type II CAs are areas where discussions of compartmented information may take place. If so equipped and approved, compartmented information may also be viewed and processed. This CA comprises a room, e.g., office or conference room, inside an accredited SCIF where compartmented discussions may be held by authorized personnel. All Type II CAs must meet existing sound transmission class (STC) requirements per ICS 705-1 to ensure that the room or office retains sound within its perimeter. In addition to compartmented discussions, Type II CAs may be used for secure video teleconferencing (SVTC) and related communication conferencing and the use of secure telephones for compartmented discussions. The use of printers, scanners, fax, copiers, and the secure transfer of data to approved removable media require prior approval. No storage is authorized, logical and/or physical.
- c) Type III: A restricted discussion area used for viewing, processing, printing, copying, storage and control of accountable compartmented information. This CA is

intended for storing and retaining compartmented information when accountability and strict control of compartmented program information is required. This includes, but is not limited to: notes, briefs, slides, electronic presentations, analytic papers, removable hard drives, field packs, thumb drives, laptops, personal electronic devices (PEDs) (see Chapter 10) or hand-held devices that store compartmented information. In addition to the storage of compartmented material in a GSA-approved container, Type III CAs may be used for processing compartmented information on approved computer workstations; the use of printers, scanners, and copiers; the secure transfer of data to approved removable media; the use of secure facsimile machines; and the use of secure telephone equipment (STE) for compartmented discussions. All personnel residing within or who have unfettered access to a Type III CA must be formally briefed into all compartments that reside within the Type III CA. Visitors are permitted within Type III areas only when all compartmented information (for which the visitor is not briefed) is stored within containers, out of sight, and no compartmented discussions occur.

3. Requirements

- a) The CA shall be approved by the AO with the concurrence of the CA Program Manager or designee. The CA Checklist (Chapter 13) shall be used to request approval.
- b) Any construction or security requirements above those listed herein require prior approval from the element head as described in ICS 705-2.

4. Access Control

- a) Access control to the CA may be accomplished by visual recognition or mechanical/electronic access control devices.
- b) Spin-dial combination locks shall not be installed on CA doors.
- c) Independent alarm systems shall not be installed in a CA.

5. Visual Protection of CA Workstations

If compartmented information will be displayed on a computer terminal or group of terminals in an area where everyone is not accessed to the program, the following measures may be applied to reduce the ability of “shoulder surfing” or inadvertent viewing of compartmented information:

- Position the computer screen away from doorway/cubicle opening.
- Use a polarizing privacy screen.
- Use partitions and/or signs.
- Existing private offices or rooms may be used but may not be a mandatory requirement.

6. Closed Storage

When the storage, processing, and use of compartmented information, product, or deliverables is required, and all information shall be stored while not in use, then all of the following shall apply:

- a) Access and visual controls identified above shall be the standard safeguard.
- b) Compartmented information shall be physically stored in a General Services Administration (GSA) approved safe.

7. Open Storage

In rare instances when open storage of information is required, the following apply:

- a) If the parent SCIF is accredited for open storage, a private office with access control on the door is adequate physical security protection.
- b) If the parent SCIF has been built and accredited for closed storage, then the CA perimeter shall be constructed and accredited to open storage standards.
- c) The CA AO may approve open or closed storage within the CA. Storage requirements shall be noted in both the CA Fixed Facility Checklist (FFC) and, if appropriate, in a Memorandum of Understanding (MOU).

8. Acoustic and Technical Security

- a) All TEMPEST, administrative telephone, and technical surveillance countermeasure (TSCM) requirements for the parent SCIF shall apply to the CA and shall be reciprocally accepted.
- b) When compartmented discussions are required, the following apply:
 - (1) Use existing rooms that have been accredited for SCI discussions.
 - (2) Use administrative procedures to restrict access to the room during conversations.

Chapter 3. Fixed Facility SCIF Construction

Requirements outlined within this chapter apply to all fixed facility SCIFs. The SCIF Pre-Construction Checklist is found in Chapter 13 and may be completed and sent to the Cognizant Security Authority (CSA) and/or AO as part of the concept approval process. All questions about the checklist content and expected information should be directed to the project CSA/AO. Additional information and requirements for facilities located outside the U.S., its possessions or territories, are found in Chapters 4 and 5. Additional information and requirements for temporary SCIFs are described in Chapter 6.

A. Personnel

Roles and responsibilities of key SCIF construction personnel are identified in ICS 705-1 and restated here for reference.

1. AO Responsibilities

- a) Provide security oversight of all aspects of SCIF construction under their security purview.
- b) Review and approve the design concept, Construction Security Plan (CSP), and final design for each construction project prior to the start of SCIF construction.
- c) Depending on the magnitude of the project, determine if the Site Security Manager (SSM) performs duties on a full-time, principal basis, or as an additional duty to on-site personnel.
- d) Accredite SCIFs under their cognizance.
- e) Prepare waiver requests for the IC element head or designee.
- f) Provide the timely input of all required SCIF data to the IC SCIF repository.
- g) Consider SID on USG or USG-sponsored contractor facilities to substitute for standards herein. (SID shall be documented in the CSP and the FFC.)

2. Site Security Managers (SSMs) Responsibilities

- a) Ensure the requirements herein are implemented and advise the AO of compliance or variances.
- b) In consultation with the AO, develop a CSP regarding implementation of the standards herein. (This document shall include actions required to document the project from start to finish.)
- c) Conduct periodic security inspections for the duration of the project to ensure compliance with the CSP.
- d) Document security violations or deviations from the CSP and notify the AO within 3 business days.
- e) Ensure that procedures to control site access are implemented.

3. CTTA Responsibilities

- a) Review SCIF construction or renovation plans to determine if TEMPEST countermeasures are required and recommend solutions. To the maximum extent practicable, TEMPEST mitigation requirements shall be incorporated into the SCIF design.
- b) Provide the CSA and AO with documented results of review with recommendations.

4. Construction Surveillance Technicians (CSTs) Responsibilities

- a) Supplement site access controls, implement screening and inspection procedures, as well as monitor construction and personnel, when required by the AO.
- b) In low and medium technical threat countries, begin surveillance of non-cleared workers at the start of SCIF construction or the installation of major utilities, whichever comes first.
- c) In high and critical technical threat countries, begin surveillance of non-cleared workers at the start of: construction of public access or administrative areas adjacent to the SCIF; SCIF construction; or the installation of major utilities, whichever comes first.

B. Construction Security

1. Prior to awarding a construction contract, a CSP for each project shall be developed by the SSM and approved by the AO.
2. Construction plans and all related documents shall be handled and protected in accordance with the CSP.
3. For SCIF renovation projects, barriers shall be installed to segregate construction workers from operational activities and provide protection against unauthorized access and visual observation. Specific guidance shall be contained in the CSP.
4. Periodic security inspections shall be conducted by the SSM or designee for the duration of the project to ensure compliance with construction design and security standards.
5. Construction and design of SCIFs should be performed by U.S. companies using U.S. citizens to reduce risk, but may be performed by U.S. companies using U.S. persons (an individual who has been lawfully admitted for permanent residence as defined in 8 U.S.C. § 1101(a)(20) or who is a protected individual as defined by Title 8 U.S.C. § 1324b (a)(3)). The AO shall ensure mitigations are implemented when using non-U.S. citizens. These mitigations shall be documented in the CSP.
6. All site control measures used shall be documented in the CSP. Among the control measures that may be considered are the following:
 - Identity verification.
 - Random searches at site entry and exit points.

- Signs at all entry points listing prohibited and restricted items (e.g., cameras, firearms, explosives, drugs, etc.).
- Physical security barriers to deny unauthorized access.
- Vehicle inspections.

C. Perimeter Wall Construction Criteria

1. General

- a) SCIF perimeters include all walls that outline the SCIF confines, floors, ceilings, doors, windows and penetrations by ductwork, pipes, and conduit. This section describes recommended methods to meet the standards described within ICS 705-1 for SCIF perimeters.
- b) Perimeter wall construction specifications vary by the type of SCIF, location, use of SID, and discussion requirements.
- c) Closed storage areas that do not require discussion areas do not have any forced entry or acoustic requirements.
- d) Open storage facilities without SID require additional protection against forced and surreptitious entry.
- e) When an existing wall is constructed with substantial material (e.g., brick, concrete, cinderblock, etc.) equal to meet the perimeter wall construction standards, the existing wall may be utilized to satisfy the specification.

2. Closed Storage, Secure Working Area (SWA), Continuous Operation, or Open Storage with SID - Use Wall A - Suggested Standard Acoustic Wall (see construction drawing for details).

- a) Three layers $\frac{5}{8}$ inch-thick gypsum wallboard (GWB), one layer on the uncontrolled side of the SCIF and two on the controlled side of the SCIF, to provide adequate rigidity and acoustic protection (Sound Class 3).
- b) Wallboard shall be attached to 3 $\frac{5}{8}$ inch-wide 16 gauge metal studs or wooden 2 x 4 studs placed no less than 16" on center (o.c.).
- c) 16 gauge continuous track (top & bottom) w/ anchors at 32" o.c. maximum) – bed in continuous bead of acoustical sealant.
- d) The interior two layers of wallboard shall be mounted so that the seams do not align (i.e., stagger joints).
- e) Acoustic fill 3 $\frac{1}{2}$ " (89mm) sound attenuation material, fastened to prevent sliding down and leaving void at the top.
- f) The top and bottom of each wall shall be sealed with an acoustic sealant where it meets the slab.

- g) Fire safe non-shrink grout, or acoustic sealant in all voids above/below track both sides of partition.
 - h) Entire wall assembly shall be finished and painted from true floor to true ceiling.
3. Open Storage without SID -- Use Wall B - Suggested Wall for Expanded Metal or Wall C - Suggested Wall for Plywood.
- a) Three layers of $\frac{5}{8}$ inch-thick GWB, one layer on the uncontrolled side of the SCIF and two on the controlled side of the SCIF to provide adequate rigidity and acoustic protection (Sound Class 3).
 - b) Wallboard shall be attached to 3 $\frac{5}{8}$ inch-wide 16 gauge metal studs or wooden 2 x 4 studs placed no less than 16" o.c.
 - c) 16 gauge continuous track (top & bottom) w/ anchors at 32" on center (o.c.) maximum) – bed in continuous bead of acoustical sealant.
 - d) Wall B - Suggested Wall for Expanded Metal (see drawing for Wall B-Suggested Construction for Expanded Metal).
 - (1) Three-quarter inch mesh, # 9 (10 gauge) expanded metal shall be affixed to the interior side of all SCIF perimeter wall studs.
 - (2) Expanded metal shall be spot-welded to the studs every six inches along the length of each vertical stud and at the ceiling and floor.
 - (3) Hardened screws with one inch washers or hardened clips may be used in lieu of welding to fasten metal to the studs. Screws shall be applied every six inches along the length of each vertical stud and at the ceiling and floor.
 - (4) Fastening method shall be noted in the FFC.
 - (5) Entire wall assembly shall be finished and painted from true floor to true ceiling.
 - e) Wall C - Suggested Wall for Plywood (see drawing for Wall C-Suggested Construction for Plywood).
 - (1) Three layers of $\frac{5}{8}$ inch-thick GWB, two layers on the uncontrolled side and one layer GWB over minimum $\frac{1}{2}$ " plywood on the controlled side of the SCIF.

NOTE: CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed in accordance with (IAW) best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the layer of plywood and GWB.

 - (2) 1/2" Plywood affixed 8' vertical by 4' horizontal to 16 gauge studs using glue and #10 steel tapping screws at 12 o.c.
 - (3) GWB shall be mounted to plywood with screws avoiding contact with studs to mitigate any possible acoustic flanking path.
 - (4) 16 gauge continuous track (top & bottom) w/ anchors at 32" o.c. maximum) – bed in continuous bead of acoustical sealant.

(5) Fire safe non-shrink grout, or acoustic sealant in all voids above/below track both sides of partition.

(6) Entire wall assembly shall be finished and painted from true floor to true ceiling.

4. Radio Frequency (RF) Protection for Perimeter Walls

a) RF protection shall be installed at the direction of the CTTA when a SCIF utilizes electronic processing and does not provide adequate RF attenuation at the inspectable space boundary. It is recommended for all applications where RF interference from the outside of the SCIF is a concern inside the SCIF.

b) Installation of RF protection should be done using either the drawings or *Best Practices Guidelines for Architectural Radio Frequency Shielding*, prepared by the Technical Requirements Steering Committee under the Center for Security Evaluation. This document is available through the Center for Security Evaluation, Office of the Director of National Intelligence (NCSC/CSE).

5. Vault Construction Criteria

GSA-approved modular vaults meeting Federal Specification AA-V-2737 or one of the following construction methods may be used:

a) Reinforced Concrete Construction

(1) Walls, floor, and ceiling will be a minimum thickness of eight inches of reinforced concrete.

(2) The concrete mixture will have a comprehensive strength rating of at least 2,500 pounds per square inch (psi).

(3) Reinforcing will be accomplished with steel reinforcing rods, a minimum of $\frac{5}{8}$ inches in diameter, positioned centralized in the concrete pour and spaced horizontally and vertically six inches on center; rods will be tied or welded at the intersections.

(4) The reinforcing is to be anchored into the ceiling and floor to a minimum depth of one-half the thickness of the adjoining member.

b) Steel-Lined Construction Where Unique Structural Circumstances Do Not Permit Construction of a Concrete Vault

(1) Construction will use $\frac{1}{4}$ inch-thick steel alloy-type plates having characteristics of high-yield and high-tensile strength.

(2) The steel plates are to be continuously welded to load-bearing steel members of a thickness equal to that of the plates.

(3) If the load-bearing steel members are being placed in a continuous floor and ceiling of reinforced concrete, they must be firmly affixed to a depth of one-half the thickness of the floor and ceiling.

(4) If floor and/or ceiling construction is less than six inches of reinforced concrete, a steel liner is to be constructed the same as the walls to form the floor

and ceiling of the vault. Seams where the steel plates meet horizontally and vertically are to be continuously welded together.

All vaults shall be equipped with a GSA-approved Class 5 vault door.

D. Floor and Ceiling Construction Criteria

1. Floors and ceilings shall be constructed to meet the same standards for force protection and acoustic protection as walls.
2. All floor and ceiling penetrations shall be kept to a minimum.

E. SCIF Door Criteria

1. Door type definitions:
 - a) Primary door: A SCIF perimeter door recognized as the main entrance.
 - b) Secondary door: A SCIF perimeter door employed as both an entry and egress door that is not the Primary door.
 - c) Emergency egress-only door: A SCIF perimeter door employed as an emergency egress door with no entry capability.
2. Primary door criteria:
 - a) There shall be only one Primary door to a SCIF.
 - b) The Primary door shall be equipped with the following:
 - (1) A GSA-approved pedestrian door deadbolt meeting the most current version of Federal Specification FF-L-2890. Previously AO-approved FFL-2740 integrated locking hardware may be used. Additional standalone and flush-mounted dead bolts are prohibited.
 - (2) A combination lock meeting the most current version of Federal Specification FFL- 2740. Previously AO-approved combination lock or deadbolt lock type may be used.
 - (3) An approved access control device (see Chapter 8). May be equipped with a by-pass keyway for use in the event of an access control system failure.
 - (4) Include requirements in E.5 below.
3. **Secondary** door criteria:
 - a) Secondary doors may be established with AO approval and as required by building code, safety and accessibility requirements,
 - (1) Secondary doors shall:
 - (a) Be equipped with a GSA-approved pedestrian door egress device with deadbolt meeting the most current version of Federal Specification FF-L-2890 for secondary door use. An AO-approved

alternate device with similar functionality may be authorized. Additional standalone and flush-mounted deadbolts are prohibited.

(b) Have approved access control hardware (see Chapter 8). The access control system must be deactivated when the SCIF is not occupied, or as determined by the AO.

(c) Include requirements in E.5 below.

4. Emergency Egress-only doors shall:
 - a) Be installed as required by building code, safety and accessibility requirements.
 - b) Be equipped with GSA-approved pedestrian door emergency egress device with deadbolt configuration meeting the most current version of Federal Specification FF-L-2890 for exit only door use. An AO-approved alternate device with similar functionality and no exterior hardware may be authorized. Additional standalone and flush-mounted deadbolts are prohibited.
 - c) Be alarmed 24/7 and have a local audible annunciator that must be activated if the door is opened.
 - d) Include requirements in E.5 below.
5. Criteria for **all** SCIF perimeter doors:
 - a) All SCIF perimeter doors shall comply with applicable building code, safety, and accessibility requirements as determined by the Authority Having Jurisdiction.
 - b) Ensure SCIF Standard Operating Procedures (SOP) includes procedures to ensure all doors are secured at end of day.
 - c) All SCIF perimeter pedestrian doors shall be equipped with an automatic, non-hold door-closer which shall be installed internal to the SCIF.
 - d) Door hinge pins that are accessible from outside of the SCIF shall be modified to prevent removal of the door, e.g., welded, set screws, dog bolts, etc.
 - e) SCIF perimeter doors and frame assemblies shall meet acoustic requirements as described in Chapter 9 unless declared a non-discussion area.
 - f) All SCIF perimeter doors shall be alarmed in accordance with Chapter 7.
 - g) SCIF Perimeter doors shall meet TEMPEST requirements per CTTA guidance.
 - h) When practical and permissible, SCIF entry doors should incorporate a vestibule to preclude visual observation and enhance door acoustic protection.
6. SCIF door fabrication and unique criteria:
 - a) Wooden SCIF doors shall be 1 ¾ inch-thick solid wood core (i.e. wood stave, structural composite lumber).
 - b) Steel doors shall meet following specifications:
 - (1) 1 ¾ inch-thick face steel equal to minimum 18-gauge steel.
 - (2) Hinges reinforced to 7-gauge steel and preferably a lift hinge.
 - (3) Door closure installation reinforced to 12-gauge steel.

- (4) Lock area predrilled and/or reinforced to 10-gauge steel.
- c) Vault doors shall not be used to control day access to a facility. To mitigate both security and safety concerns, a vestibule with an access control device may be constructed for the purpose of day access to the vault door.
- d) Roll-up Doors shall be minimum 18-gauge steel and shall be secured inside the SCIF using dead-bolts on both the right and left side of the door and alarmed in accordance with Chapter 7.
- e) SCIF perimeter Double Door Specifications:
 - (1) The fixed leaf shall be secured at the top and bottom with deadbolts.
 - (2) An astragal shall be attached to one door.
 - (3) Each leaf of the door shall have an independent security alarm contact.
- f) Adjacent SCIF adjoining doors:
 - (1) Doors that join adjacent SCIFs, not required for emergency egress, shall:
 - (a) Be dead bolted on both sides.
 - (b) Be alarmed on both sides according to chapter 7.
 - (c) Meet acoustic requirements as required.
 - (d) Be covered by AO SOP.
- g) Other door types shall be addressed on an individual basis as approved by the AO.

F. SCIF Window Criteria

1. Every effort should be made to minimize or eliminate windows in the SCIF, especially on the ground floor.
2. Windows shall be non-opening.
3. Windows shall be protected by security alarms in accordance with Chapter 7 when they are within 18 feet of the ground or an accessible platform.
4. Windows shall provide visual and acoustic protection.
5. Windows shall be treated to provide RF protection when recommended by the CTTA.
6. All windows less than 18 feet above the ground or from the nearest platform affording access to the window (measured from the bottom of the window), shall be protected against forced entry and meet the standard for the perimeter.

G. SCIF Perimeter Penetrations Criteria

1. All penetrations of perimeter walls shall be kept to a minimum.
2. Metallic penetrations may require TEMPEST countermeasures, to include dielectric breaks or grounding, when recommended by the CTTA.
3. Utilities servicing areas other than the SCIF shall not transit the SCIF unless mitigated with AO approval. This restriction does not apply to secure communication

lines required to transit a SCIF to service an adjacent SCIF through a common perimeter surface.

4. Electrical Utilities should enter the SCIF at a single point.
5. All utility (power and signal) distribution on the interior of a perimeter wall treated for acoustics or RF shall be surface mounted, contained in a raceway, or an additional wall shall be constructed using furring strips as stand-off from the existing wall assembly. If the construction of an additional wall is used, gypsum board may be $\frac{3}{8}$ inch-thick and need only go to the false ceiling.
6. Installation of additional conduit penetration for future utility expansion is permissible provided the expansion conduit is filled with acoustic fill and capped (end of pipe cover).
7. Vents and Ducts
 - a) All vents and ducts shall be protected to meet the acoustic requirements of the SCIF. (See Figure 4, Typical Air (Z) Duct Penetration, for example.)
 - b) Walls surrounding duct penetrations shall be finished to eliminate any opening between the duct and the wall.
 - c) All vents or duct openings that penetrate the perimeter walls of a SCIF and exceed 96 square inches shall be protected with permanently affixed bars or grills.
 - (1) If one dimension of the penetration measures less than six inches, bars or grills are not required.
 - (2) When metal sound baffles or wave forms are permanently installed and set no farther apart than six inches in one dimension, then bars or grills are not required.
 - (3) If bars are used, they shall be a minimum of $\frac{1}{2}$ inch diameter steel, welded vertically and horizontally six inches on center; a deviation of $\frac{1}{2}$ inch in vertical and/or horizontal spacing is permissible.
 - (4) If grilles are used they shall be of:
 - (a) $\frac{3}{4}$ inch-mesh, #9 (10 gauge), case-hardened, expanded metal; or
 - (b) expanded metal diamond mesh, 1-1/2" #10 (1-3/8" by 3" openings, 0.093" thickness, with at least 80% open design) tamperproof; or
 - (c) welded wire fabric (WWF) 4x4 W2.9xW2.9 (6 gauge smooth steel wire welded vertically and horizontally four inches o.c.).
 - (5) If bars, grilles, or metal baffles/wave forms are required, an access port shall be installed inside the secure perimeter of the SCIF to allow visual inspection of the bars, grilles, or metal baffles/wave forms. If the area outside the SCIF is controlled (SECRET or equivalent proprietary space), the inspection port may be

installed outside the perimeter of the SCIF and be secured with an AO-approved high-security lock. This shall be noted in the FFC.

H. Alarm Response Time Criteria for SCIFs within the U.S.

Response times for Intrusion Detection Systems (IDS) shall meet 32 CFR Parts 2001 and 2004.

- a) Closed Storage response time of 15 minutes.
- b) Open Storage response time within 15 minutes of the alarm annunciation if the area is covered by SID or a five minute alarm response time if it is not.

I. Secure Working Areas (SWA)

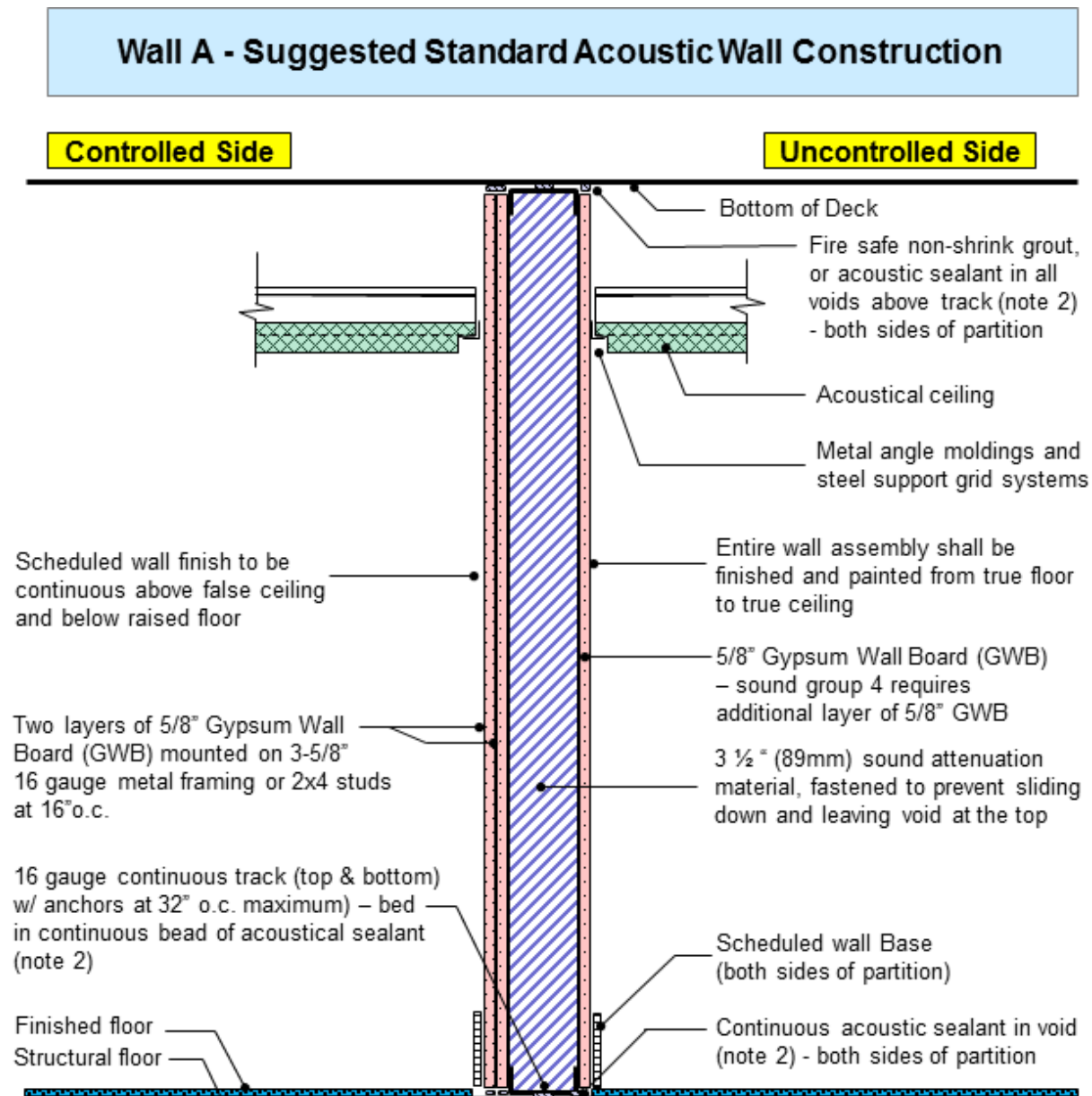
SWAs are accredited facilities used for discussing, handling, and/or processing SCI, but where SCI will not be stored.

1. The SWA shall be controlled at all times by SCI-indoctrinated individuals or secured with a GSA-approved combination lock.
2. The SCIF shall be alarmed in accordance with Chapter 7 with an initial alarm response time of 15 minutes.
3. Access control shall be in accordance with Chapter 8.
4. Perimeter construction shall comply with section 3.C. above.
5. All SCI used in an SWA shall be removed and stored in GSA-approved security containers within a SCIF, a vault, or be destroyed when the SWA is unoccupied.

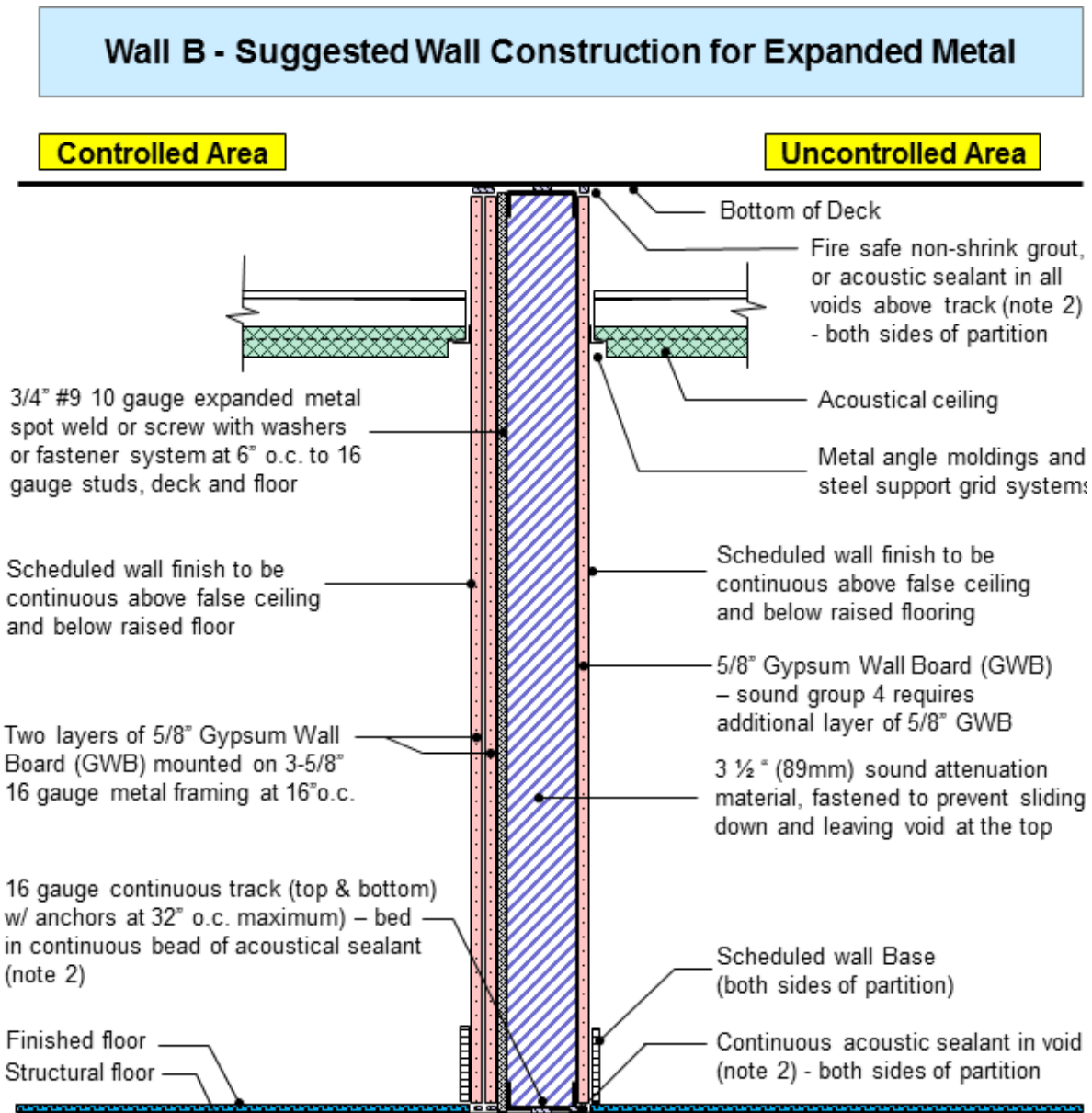
J. Temporary Secure Working Area (TSWA)

TSWAs are accredited facilities where handling, discussing, and/or processing of SCI is limited to less than 40-hours per month and the accreditation is limited to 12 months or less. Extension requests require a plan to accredit as a SCIF or SWA. Storage of SCI is not permitted within a TSWA.

1. When a TSWA is in use at the SCI level, access shall be limited to SCI-indoctrinated persons.
2. The AO may require an alarm system.
3. No special construction is required.
4. When the TSWA is approved for SCI discussions, sound attenuation specifications of Chapter 9 shall be met.
5. The AO may require a TSCM evaluation if the facility has not been continuously controlled at the SECRET level.
6. When the TSWA is not in use at the SCI level, the following shall apply:
 - a) The TSWA shall be secured with a high-security, AO-approved key or combination lock.
 - b) Access shall be limited to personnel possessing a minimum U.S. SECRET clearance.

Figure 1**Wall A – Suggested Standard Acoustic Wall Construction****Notes:**

- 1 CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed IAW best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the two layers of GWB.
- 2 Partition shall be sealed continuously with acoustical sealant whenever it abuts another element (e.g., wall, column, mullion, etc.)
- 3 Any electrical or communications outlets required on the perimeter wall shall be surface mounted.

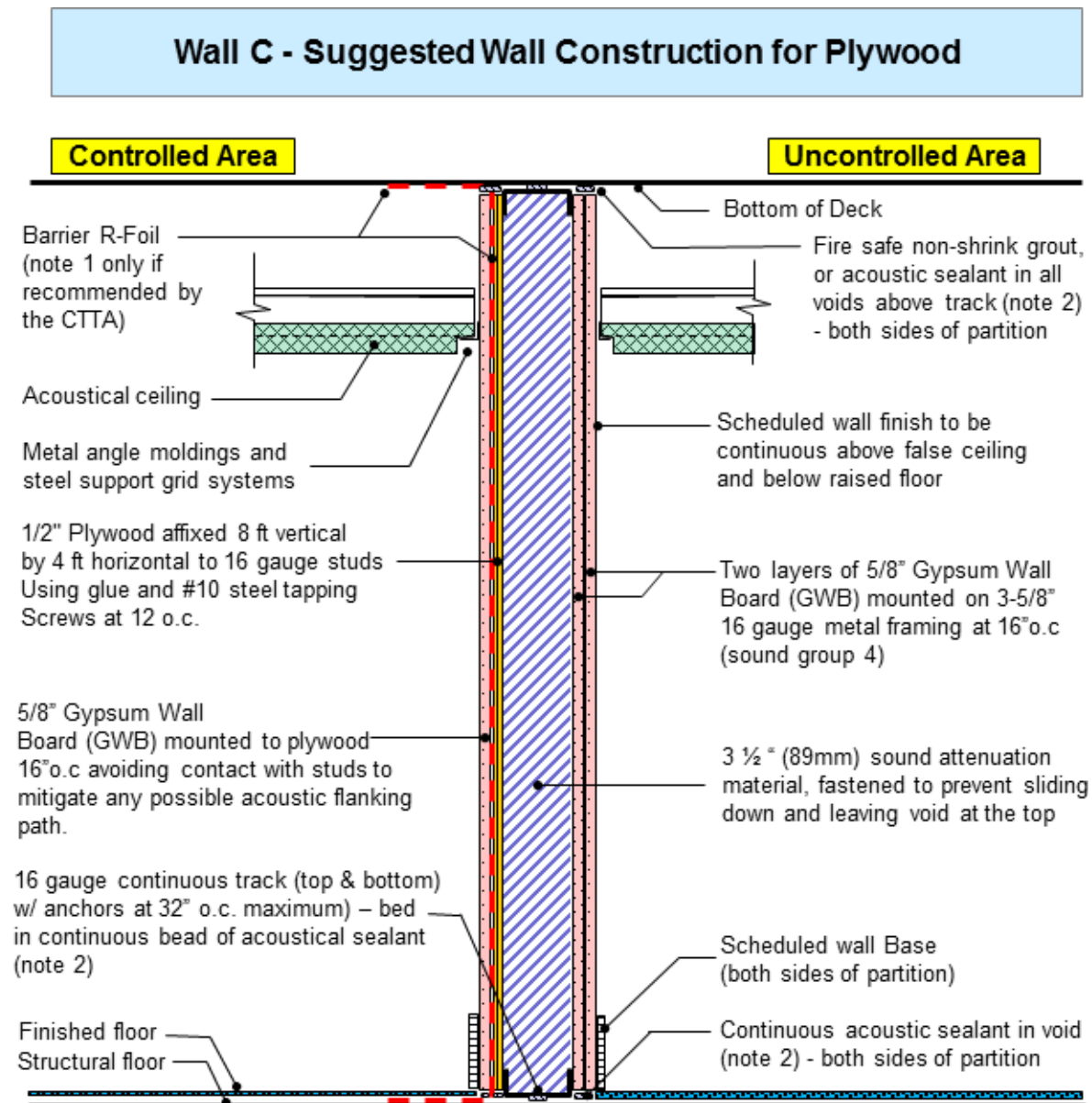
Figure 2**Wall B - Suggested Construction for Expanded Metal****Notes:**

1 CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed IAW best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the two layers of GWB.

2 Partition shall be sealed continuously with acoustical sealant whenever it abuts another element (e.g., wall, column, mullion, etc.)

3 Any electrical or communications outlets required on the perimeter wall shall be surface mounted.

Figure 3
Wall C – Suggested Construction for Plywood



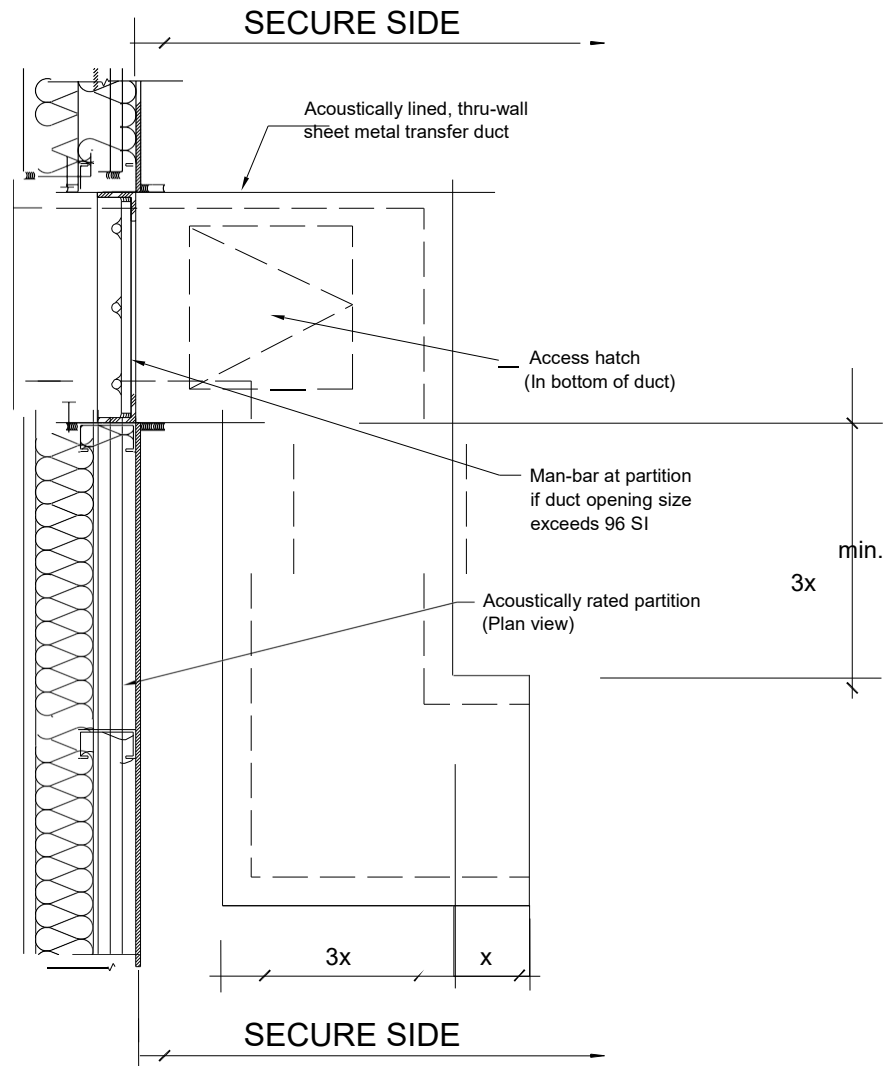
Notes:

1 CTTA recommended countermeasures (foil backed GWB or layer of approved Ultra Radiant R-Foil) shall be installed IAW best practices for architectural Radio Frequency (RF) shielding. Foil shall be located between the layer of plywood and GWB.

2 Partition shall be sealed continuously with acoustical sealant whenever it abuts another element (e.g., wall, column, mullion, etc.).

3 Any electrical or communications outlets required on the perimeter wall shall be surface mounted.

Figure 4
Typical Perimeter Air (Z) Duct Penetration



Rev. 04-05

Chapter 4. SCIFs Outside the U.S. and NOT Under Chief of Mission (COM) Authority

A. General

1. Requirements outlined here apply only to SCIFs located outside of the U.S., its territories and possessions that are not under COM authority.
2. The application and effective use of SID may allow AOs to deviate from this guidance at Category II and III facilities.

B. Establishing Construction Criteria Using Threat Ratings

1. The Department of State's (DoS) Security Environment Threat List (SETL) shall be used in the selection of appropriate construction criteria based on technical threat rating.
2. If the SETL does not have threat information for the city of construction, the SETL threat rating for the closest city within a given country shall apply. When only the capital is noted, it will represent the threat for all SCIF construction within that country.
3. Based on technical threat ratings, building construction has been divided into the following three categories for construction purposes:
 - Category I - Critical or High Technical Threat, High Vulnerability Buildings
 - Category II - High Technical Threat, Low Vulnerability Buildings
 - Category III - Low and Medium Technical Threat
4. Facilities in Category I Areas
 - a) Open Storage Facilities
 - (1) Open storage is to be avoided in Category I areas. The head of the IC element shall certify mission essential need and approve on case-by-case basis. When approved, open storage should only be allowed when the host facility is manned 24-hours-per-day by a cleared U.S. presence or the SCIF is continuously occupied by U.S. SCI-indoctrinated personnel.
 - (2) SCI shall be contained within approved vaults or Class M or greater modular vaults.
 - (3) The SCIF shall be alarmed in accordance with Chapter 7.
 - (4) Access control shall be in accordance with Chapter 8.
 - (5) An alert system and/or duress alarm is recommended.
 - (6) Initial alarm response time shall be five minutes.

- b) Closed Storage Facilities
 - (1) The SCIF perimeter shall provide five minutes of forced-entry protection. (Refer to Wall B or Wall C construction methods.)
 - (2) The SCIF shall be alarmed in accordance with Chapter 7.
 - (3) Access control system shall be in accordance with Chapter 8.
 - (4) SCI shall be stored in GSA-approved containers or in an area that meets vault construction standards.
 - (5) Initial alarm response time shall be within 15 minutes.
 - c) Continuous Operation Facilities
 - (1) An alert system and duress alarm is required.
 - (2) The capability shall exist for storage of all SCI in GSA-approved security containers or vault.
 - (3) The emergency plan shall be tested semi-annually.
 - (4) Perimeter walls shall comply with enhanced wall construction methods in accordance Wall B or C standards.
 - (5) The SCIF shall be alarmed in accordance with Chapter 7.
 - (6) Access control shall be in accordance with Chapter 8.
 - (7) Initial response time shall be five minutes.
 - d) SWAs

Construction and use of SWAs is not authorized for facilities in Category I areas because of the significant risk to SCI.
 - e) TSWAs

Construction and use of TSWAs is not authorized for facilities in Category I areas because of the significant risk to SCI.
5. Facilities in Category II and III Areas
- a) Open Storage Facilities
 - (1) Open storage is to be avoided in Category II areas. The head of the IC element shall certify mission essential need and approve on case-by-case basis. When approved, open storage should only be allowed when the host facility is manned 24-hours-per-day by a cleared U.S. presence or the SCIF is continuously occupied by U.S. SCI-indoctrinated personnel.
 - (2) In Category III areas, open storage should only be allowed when the host facility is manned 24-hours-per-day by a cleared U.S. presence or the SCIF is continuously occupied by U.S. SCI-indoctrinated personnel.
 - (3) The SCIF perimeter shall provide five minutes of forced-entry protection. (Refer to Wall B or Wall C construction methods.)

Chapter 4
SCIFs Outside the U.S. and NOT Under COM

- (4) The SCIF shall be alarmed in accordance with Chapter 7.
- (5) Access control shall be in accordance with Chapter 8.
- (6) An alert system and/or duress alarm is recommended.
- (7) Initial alarm response time shall be five minutes.
- b) Closed Storage Facilities
 - (1) The SCIF perimeter shall provide five minutes of forced-entry protection. (Refer to Wall B or Wall C construction methods.)
 - (2) The SCIF must be alarmed in accordance with Chapter 7.
 - (3) Access control system shall be in accordance with Chapter 8.
 - (4) SCI shall be stored in GSA-approved containers.
 - (5) Initial alarm response time shall be within 15 minutes.
- c) Continuous Operation Facilities
 - (1) Wall A - Standard wall construction shall be utilized.
 - (2) The SCIF shall be alarmed in accordance with Chapter 7.
 - (3) Access control shall be in accordance with Chapter 8.
 - (4) Initial response time shall be five minutes.
 - (5) An alert system and/or duress alarm is recommended.
 - (6) The capability shall exist for storage of all SCI in GSA-approved security containers.
 - (7) The emergency plan shall be tested semi-annually.
- d) SWAs
 - (1) Perimeter walls shall comply with standard Wall A construction.
 - (2) The SCIF shall be alarmed in accordance with Chapter 7.
 - (3) Access control shall be in accordance with Chapter 8.
 - (4) Initial alarm response time shall be within 15 minutes.
 - (5) The SWA shall be controlled at all times by SCI-indoctrinated individuals or secured with a GSA-approved combination lock.
 - (6) An alert system and/or duress alarm is recommended.
 - (7) All SCI used in an SWA shall be removed and stored in GSA-approved security containers within a SCIF or be destroyed.
 - (8) The emergency plan shall be tested semi-annually.
- e) TSWAs
 - (1) No special construction is required.
 - (2) The AO may require an alarm system.

- (3) When the TSWA is approved for SCI discussions, sound attenuation specifications of Chapter 9 shall be met.
- (4) When a TSWA is in use at the SCI level, access shall be limited to SCI-indoctrinated persons.
- (5) The AO may require a TSCM evaluation if the facility has not been continuously controlled at the SECRET level.
- (6) When a TSWA is **not** in use at the SCI level, the following shall apply:
 - (a) The TSWA shall be secured with a high security, AO-approved key or combination lock.
 - (b) Access shall be limited to personnel possessing a U.S. SECRET clearance.

C. Personnel

1. SSM Responsibilities

- a) Ensures the security integrity of the construction site (hereafter referred to as the “site”).
- b) Develops and implements a CSP.
- c) Ensures that the SSM shall have 24-hour unrestricted access to the site (or alternatives shall be stated in CSP).
- d) Conducts periodic security inspections for the duration of the project to ensure compliance with the CSP.
- e) Documents security violations or deviations from the CSP and notifies the AO.
- f) Maintains a list of all workers used on the project; this list shall become part of the facility accreditation files.
- g) Implements procedures to deny unauthorized site access.
- h) Works with the construction firm(s) to ensure security of the construction site and compliance with the requirements set forth in this document.
- i) Notifies the AO if any construction requirements cannot be met.

2. CST Requirements and Responsibilities

- a) Possesses U. S. TOP SECRET clearances.
- b) Is specially trained in surveillance and the construction trade to deter technical penetrations and thwart implanted technical collection devices.
- c) Supplements site access controls, implements screening and inspection procedures, and, when required by the CSP, monitors construction and personnel.
- d) Is not required when U.S. TOP SECRET-cleared contractors are used
- e) In Category III countries, must do the following:

- (1) Shall begin surveillance of non-cleared workers at the start of SCIF construction or the installation of major utilities, whichever comes first.
 - (2) Upon completion of all work, shall clear and secure the areas for which they are responsible prior to turning control over to the cleared American guards (CAGs).
 - f) In Category I and II countries, must do the following:
 - (1) Shall begin surveillance of non-cleared workers at the start of construction of public access or administrative areas adjacent to the SCIF, SCIF construction, or the installation of major utilities, whichever comes first.
 - (2) Upon completion of all work, shall clear and secure the areas for which the CST is responsible prior to turning over control to the CAGs.
 - g) On U.S. military installations, when the AO considers the risk acceptable, alternative countermeasures may be substituted for the use of a CST as prescribed in the CSP.
3. CAG Requirements and Responsibilities
- a) Possesses a U.S. SECRET clearance (TOP SECRET required under COM authority)
 - b) Performs access-control functions at all vehicle and pedestrian entrances to the site except as otherwise noted in the CSP.
 - (1) Screens all non-cleared workers, vehicles, and equipment entering or exiting the site.
 - (2) Denies introduction of prohibited materials, such as explosives, weapons, electronic devices, or other items as specified by the AO or designee.
 - (3) Conducts random inspections of site areas to ensure no prohibited materials have been brought on to the site. (All suspicious materials or incidents shall be brought to the attention of the SSM or CST.)

D. Construction Security Requirements

- 1. Prior to awarding a construction contract, a CSP for each project shall be developed by the SSM and approved by the AO.
- 2. Construction plans and all related documents shall be handled and protected in accordance with the CSP.
- 3. For SCIF renovation projects, barriers shall be installed to segregate construction workers from operational activities. These barriers will provide protection against unauthorized access and visual observation. Specific guidance shall be contained in the CSP.
- 4. When expanding existing SCIF space into areas not controlled at the SECRET level, maximum demolition of the new SCIF area is required.

5. For areas controlled at the SECRET level, or when performing renovations inside existing SCIF space, maximum demolition is not required.
6. All requirements for demolition shall be documented in the CSP.
7. Citizenship and Clearance Requirements for SCIF Construction Personnel
 - a) Use of workers from countries identified in the SETL as “critical technical threat level” or listed on the DoS Prohibited Countries Matrix is prohibited.
 - b) General construction of SCIFs shall be performed using U.S. citizens and U.S. firms.
 - c) SCIF finish work (work that includes closing up wall structures; installing, floating, taping and sealing wallboards; installing trim, chair rail, molding, and floorboards; painting; etc.) in Category III countries shall be accomplished by SECRET-cleared, U.S. personnel.
 - d) SCIF finish work (work that includes closing up wall structures; installing, floating, taping and sealing wallboards; installing trim, chair rail, molding, and floorboards; painting; etc.) in Category I and II countries shall be accomplished by TOP SECRET-cleared, U.S. personnel.
 - e) On military facilities, the AO may authorize foreign national citizens or firms to perform general construction of SCIFs. In this situation, the SSM shall prescribe, with AO approval, mitigating strategies to counter security and counterintelligence threats.
 - f) All non-cleared construction personnel shall provide the SSM with biographical data (full name, current address, Social Security Number (SSN), date and place of birth (DPOB), proof of citizenship, etc.), and fingerprint cards as allowed by local laws prior to the start of construction/renovation.
 - (1) Two forms of I-9 identification are required to verify U.S. persons.
 - (2) Whenever host nation agreements or Status of Forces Agreements make this information not available, it shall be addressed in the CSP.
 - g) When non-U.S. citizens are authorized by the AO:
 - (1) The SSM shall conduct checks of criminal and subversive files, local, national, and host country agency files, through liaison channels and consistent with host country laws.
 - (2) Checks shall be conducted of CIA indices through the country’s Director of National Intelligence (DNI) representative and appropriate in-theater U.S. military authorities.
 - h) Access to sites shall be denied or withdrawn if adverse security, Counterintelligence (CI), or criminal activity is revealed. The SSM shall notify the AO when access to the site is denied or withdrawn.
 - i) For new facilities, the following apply:
 - (1) Non-cleared workers, monitored by CSTs, may perform the installation of major utilities and feeder lines.

Chapter 4
SCIFs Outside the U.S. and NOT Under COM

- (2) Installation shall be observed at perimeter entry points and when any trenches are being filled.
 - (3) The number of CSTs shall be determined by the size of the project (square footage and project scope) as outlined in the CSP.
 - j) For existing facilities, the following apply:
 - (1) Non-cleared workers, monitored by CSTs or cleared escorts, may perform maximum demolition and debris removal.
 - (2) TOP SECRET-cleared workers shall be used to renovate or construct SCIF space.
 - (3) SECRET-cleared individuals may perform the work when escorted by TOP SECRET-cleared personnel.
 - (4) SCI-indoctrinated escorts are not required when the existing SCIF has been sanitized or a barrier has been constructed to separate the operational areas from the areas identified for construction.
 - k) Prior to initial access to the site, all construction personnel shall receive a security briefing by the SSM or designee on the security procedures to be followed.
 - l) If a construction worker leaves the project under unusual circumstances, the SSM shall document the occurrence and notify the AO. The AO shall review for CI concerns.
 - m) The SSM may require cleared escorts or CSTs for non-cleared workers performing work exterior to the SCIF that may affect SCIF security.
 - n) The ratio of escort personnel to construction personnel shall be determined by the SSM on a case-by-case basis and documented in the CSP. Prior to assuming escort duties, all escorts shall receive a briefing regarding their responsibilities.
8. Access Control of Construction Sites
- a) Access control to the construction site and the use of badges are required.
 - b) Guards are required for SCIF construction outside the U.S.
 - c) All site control measures used shall be documented in the CSP. The following are site control measures that should be considered:
 - Identity verification.
 - Random searches at site entry and exit points.
 - Signs, in English and other appropriate languages, at all entry points listing prohibited and restricted items (e.g., cameras, firearms, explosives, drugs, etc.).
 - Physical security barriers to deny unauthorized access.
 - Vehicle inspections.

d) Guards

- (1) Local guards, supervised by CAGs and using procedures established by the AO and documented in the CSP, may search all non-cleared personnel, bags, toolboxes, packages, etc., each time they enter or exit the site.
- (2) In Category I countries, CAGs shall be assigned to protect the site and surrounding area as defined in the CSP.
- (3) For existing SCIFs, TOP SECRET/SCI-indoctrinated guards are not required to control access to the site or secure storage area (SSA) provided that TOP SECRET/SCI-indoctrinated personnel are present on a 24-hour basis and prescribed post security resources are in place.
- (4) Use of non-cleared U.S. guards or non-U.S. guards to control access to the site or SSA requires the prior approval of the AO. A SECRET-cleared, U.S. citizen must supervise any non-cleared or non-U.S. guards. Non-cleared or non-U.S. guards shall not have unescorted access to the site.

E. Procurement of Construction Materials

1. General Standards. These standards apply to construction materials (hereafter referred to as “materials”) used in SCIF construction outside the U.S. These standards do not apply to installations on a roof contiguous to the SCIF provided there is no SCIF penetration.

- a) Procurements shall be in accordance with Federal Acquisition Regulations.
 - b) In exceptional circumstances, SSMs may deviate from procurement standards with a waiver; such deviation shall be noted in the CSP.
 - c) For building construction projects in Category III countries, cleared U.S. citizens may randomly select up to 35% of building materials from non-specific general construction materials for SCIF construction. Random selection may exceed 35% only if materials can be individually inspected.
 - d) For building construction projects in Category I and II countries, cleared U.S. citizens may randomly select up to 25% of building materials from non-specific general construction materials for SCIF construction. Random selection may exceed 25% only if materials can be individually inspected.
 - e) Procurement of materials from host or third party countries identified in the SETL as critical for technical intelligence or listed in the DoS Prohibited Countries Matrix is prohibited.
 - f) All such materials must be selected immediately upon receipt of the shipment and transported to secure storage.
2. Inspectable (e.g., See Chapter 13 Inspectable Materials Checklist) Materials
- a) Inspectable materials may be procured from U.S. suppliers without security restrictions.

- b) The purchase of inspectable materials from host or third party countries requires advanced approval from the AO.
 - c) Procurement of materials from host or third party countries identified in the SETL as critical for technical intelligence or listed in the DoS Prohibited Countries Matrix is prohibited.
 - d) All inspectable materials procured in host and third party countries, or shipped to site in unsecured manner, shall be inspected using an AO-approved method as outlined in the CSP and then moved to an SSA.
 - e) Random selection of all inspectable material selected from stock stored outside of the SSA shall be inspected using AO-approved methods outlined in the CSP prior to use in SCIF construction.
3. Non-Inspectable Materials
- a) Non-inspectable materials may be procured from U.S. suppliers or other AO-approved channels with subsequent secure transportation to the SSA at the construction site.
 - b) Non-inspectable materials may be procured in a host or third party country if randomly selected by U.S. citizens with a security clearance level approved by the AO.
 - c) Materials shall be randomly chosen from available suppliers (typically three or more) without advance notice to, or referral from, the selected supplier and without reference of the intended use of material in a SCIF.
 - d) Selections shall be made from available shelf stock and transported securely to an SSA.
 - e) Procurement officials should be circumspect about continually purchasing non-inspectable materials from the same local suppliers, and thereby establishing a pattern that could be reasonably discernible by hostile intelligence services, foreign national staff, and suppliers.

F. Secure Transportation for Construction Material

1. Inspectable Materials
- a) Secure transportation of inspectable materials is not required, but materials shall be inspected using procedures approved by the AO prior to use.
 - b) Once inspected, all inspectable materials shall be stored in a SSA prior to use.
 - c) If securely procured, securely shipped, and stored in a secure environment, inspectable materials may be utilized within the SCIF without inspection.
2. Non-Inspectable Materials
- a) Non-inspectable materials include inspectable materials when the site does not possess the capability to inspect them by AO-approved means.

b) Non-inspectable materials shall be securely procured and shipped to site by secure transportation from the U.S., a secure logistics facility, or low threat third party country using one of the following secure methods:

- (1) Securely packaged or containerized and under the 24-hour control of an approved courier or escort office. (Escorted shipments shall be considered compromised if physical custody or direct visual observation is lost by the escort officer during transit. Non-inspectable materials that are confirmed or suspected of compromise shall not be used in a SCIF.)
- (2) Securely shipped using approved transit security technical safeguards capable of detecting evidence of tampering or compromise. (An unescorted container protected by technical means (“trapped”) is considered compromised if evidence of tampering of the protective technology is discovered, or if an unacceptable deviation from the approved transit security plan occurs. Non-inspectable materials that are confirmed or suspected of compromise shall not be used in a SCIF.).
- (3) Non-inspectable materials shall be shipped using the following surface and air carriers in order of preference:
 - U.S. Military
 - U.S. Flag Carriers
 - Foreign Flag Carriers

G. Secure Storage of Construction Material

1. A SSA shall be established and maintained for the secure storage of all SCIF construction material and equipment. An SSA is characterized by true floor to true ceiling, slab-to-slab construction of some substantial material, and a solid wood-core or steel-clad door equipped with an AO-approved security lock.
2. All inspected and securely shipped materials shall be placed in the SSA upon arrival and stored there until required for installation.
3. Alternative SSAs may include the following:
 - a) A shipping container located within a secure perimeter that is locked, alarmed, and monitored.
 - b) A room or outside location enclosed by a secure perimeter that is under direct observation by a SECRET-cleared U.S. citizen.
4. The SSA shall be under the control of CAGs or other U.S. personnel holding at least U.S. SECRET clearances.
5. Supplemental security requirements for SSAs shall be set forth in the CSP and may vary depending on the location and/or threat to the construction site.

H. Technical Security

1. TEMPEST countermeasures shall be pre-engineered into the construction of the SCIF.
2. In Category I countries, a TSCM inspection shall be required for new SCIF construction or for significant renovations (50% or more of SCIF replacement cost).
3. In Category II and III countries, a TSCM inspection may be required by the AO for new SCIF construction or significant renovations (50% or more of SCIF replacement cost).
4. A TSCM inspection shall be required if uncontrolled space is converted (maximum demolition) to new SCIF space.
5. When a TSCM inspection is not conducted, a mitigation strategy based on a physical security inspection that identifies preventative and corrective countermeasures shall be developed to address any technical security concerns.

I. Interim Accreditations

1. Upon completion of a successful inspection, the respective agency's AO may issue an Interim Accreditation pending receipt of required documentation.
2. If documentation is complete, AOs may issue an Interim Accreditation pending the final inspection.

Chapter 4
SCIFs Outside the U.S. and NOT Under COM

This page intentionally left blank.

Chapter 5. SCIFs Outside the U.S. and Under Chief of Mission Authority**A. Applicability**

1. This portion applies to the construction of SCIFs located overseas and that are on any compound that falls under the DoS COM authority or created to support any Tenant Agency that falls under COM authority.
2. The creation of new SCIF space at facilities that fall under COM authority is governed by both ICDs and Overseas Security Policy Board (OSPB) standards published as 12 Foreign Affairs Handbook-6 (12 FAH-6). If there is a conflict between the standards, the more stringent shall apply.
3. For SCIFs constructed in new facilities (new compound or new office building under COM authority), the proponent activity shall coordinate specific requirements for the proposed SCIF with the DoS/Overseas Buildings Operations (OBO).
4. For SCIFs constructed in existing facilities under COM authority, the project proponent activity must coordinate SCIF requirements with DoS/Bureau of Diplomatic Security (DS), the affected Embassy or Consulate (through the Regional Security Officer (RSO) and General Services Officer (GSO)), and DoS/OBO.
5. Upon an upgrade in the SETL Technical Threat rating for a facility under COM authority, the tenant agency in concert with the RSO, shall conduct a survey for OSPB compliance to the new technical threat requirements, and document any compliance issues accordingly. Upgrade requirements shall be coordinated through the RSO, GSO, and DoS/OBO and DS.
6. Temporary SCIFs may only be authorized by exception for facilities under COM authority. The AO of the tenant agency shall notify both the RSO and the DoS AO of the requirement and the expected duration of these facilities. Prior to accreditation, the tenant agency AO must coordinate with the DoS AO.

B. General Guidelines

1. SCIFs located under COM authority outside the U.S. are located within the CAA.
2. Prior to initiating any SCIF implementation process for upgrade or new construction in an existing office building, the tenant agency CSA shall do the following:
 - a) Obtain concurrence from the Post's Counterintelligence Working Group (CIWG).
 - b) Obtain written approval from the COM.
 - c) Notify the DoS AO of CWIG and COM approvals.
 - d) Coordinate OSPB preliminary survey with the post RSO/Engineering Services Office (ESO) if space is not core CAA.
3. A Preliminary Survey shall be developed by the RSO/ESO and submitted to DoS/DS for review and approval prior to awarding a construction contract. A CSP shall then be developed by the tenant and forwarded to DoS/OBO for processing.

4. All SCIF design, construction, or renovation shall be in compliance with OSPB standards for facilities under COM authority.
5. Any waivers that are granted for a SCIF by a waiver authority that would result in non-compliance with OSPB standards shall require an exception to OSPB standards from DoS/DS.
6. Written approval of the request for an exception to OSPB standards must be received prior to the commencement of any construction projects.
7. Upon completion of construction, the tenant agency AO will accredit the SCIF for SCI operations.

C. Threat Categories

1. The DoS SETL shall be used in the selection of appropriate construction criteria. Based on technical threat ratings, building construction has been divided into three categories for construction purposes:
 - Category I - Critical or High Technical Threat, High Vulnerability Buildings
 - Category II - High Technical Threat, Low Vulnerability Buildings
 - Category III - Low and Medium Technical Threat
2. High and Low Vulnerability Buildings will be determined in accordance with the definitions in the OSPB standards.
3. SCIF design and construction shall comply with the building codes utilized by DoS/OBO.
4. SCIF construction projects are subject to the DoS Construction Security Certification requirements stipulated in Section 160 (a), Public Law 100-204, as amended. Construction activities may not commence until the required certification has been obtained from DoS.
5. SCIF construction projects are subject to permit requirements established by DoS/OBO.
6. Open storage in Category I and II areas is to be avoided. The CSA shall certify mission-essential need and approve on a case-by-case basis.
7. Open storage shall only be allowed for Category III posts when the host facility is manned 24-hours per day by a cleared U.S. presence (i.e., Marine Security Guard).
8. Open storage of SCI material is not authorized in lock-and-leave facilities (i.e., no Marine Security Guard).

D. Construction Requirements

1. Perimeter Wall Construction (all facilities regardless of type or location).

Chapter 5
SCIFs Outside the U.S. and Under COM

- a) Perimeter walls shall comply with enhanced wall construction (See drawings for Walls B and C.)
- b) Perimeter shall meet acoustic protection standards unless designated as a non-discussion area.
- 2. All SCIFs must be alarmed in accordance with Chapter 7.
- 3. Initial alarm response times shall be within 15 minutes for closed storage and five minutes for open storage.
- 4. Access control systems shall be in accordance with Chapter 8.
- 5. SCI shall be stored in GSA-approved containers.
- 6. An alert system and/or duress alarm is recommended.
- 7. Continuous Operation Facilities
 - a) An alert system and/or duress alarm is recommended.
 - b) The capability shall exist for storage of all SCI in GSA-approved security containers.
 - c) The emergency plan shall be tested semi-annually.
 - d) The SCIF shall be alarmed in accordance with Chapter 7.
 - e) Access control shall be in accordance with Chapter 8.
 - f) Initial response time shall be five minutes.
- 8. TSWAs
 - a) When a TSWA is in use at the SCI level, the following apply:
 - (1) Unescorted access shall be limited to SCI-indoctrinated persons.
 - (2) The AO may require an alarm system.
 - (3) No special construction is required.
 - (4) When the TSWA is approved for SCI discussions the following apply:
 - (a) Sound attenuation specifications of Chapter 9 shall be met.
 - (b) The AO may require a TSCM evaluation if the facility has not been continuously controlled at the SECRET level.
 - b) When the TSWA is **not** in use at the SCI level, the following shall apply:
 - (1) The TSWA shall be secured with a DoS/DS-approved key or combination lock.
 - (2) Unescorted access shall be limited to personnel possessing a U.S. SECRET clearance.
- 9. SWA
 - a) Initial alarm response times shall be within 15 minutes.

- b) The SWA shall be controlled at all times by SCI-indoctrinated individuals or secured with a GSA-approved combination lock.
- c) The SWA shall be alarmed in accordance with Chapter 7.
- d) Access control shall be in accordance with Chapter 8.
- e) Perimeter walls shall comply with standard Wall A.
- f) An alert system and/or duress alarm is recommended.
- g) All SCI used in a SWA shall be removed and stored in GSA-approved security containers within a SCIF or be destroyed.
- h) There shall be an emergency plan that is tested semi-annually.

E. Personnel

1. SSM Requirements and Responsibilities

- a) Possesses a U.S. TOP SECRET clearance.
- b) Ensures the security integrity of the construction site.
- c) Develops and implements a CSP.
- d) Shall have 24-hour unrestricted access to the site (or alternatives shall be stated in CSP).
- e) Conducts periodic security inspections for the duration of the project to ensure compliance with the CSP.
- f) Documents security violations or deviations from the CSP and notifies the RSO and the tenant AO.
- g) Maintains a list of all workers utilized on the project; this list shall become part of the facility accreditation files.
- h) Implements procedures to deny unauthorized site access.
- i) Works with the construction firm(s) to ensure security of the construction site and compliance with the requirements set forth in this document.
- j) Notifies the RSO and tenant AO if any construction requirement cannot be met.

2. CST Requirements and Responsibilities

- a) Possesses a TOP SECRET clearance.
- b) Is specially trained in surveillance and the construction trade to deter technical penetrations and to detect implanted technical collection devices.
- c) Supplements site access controls, implements screening and inspection procedures, and when required by the CSP, monitors construction and personnel.
- d) Is not required when contractors who are U.S. citizens with U.S. TOP SECRET clearances are used.

- e) In Category III countries the following shall apply:
 - (1) The CST shall begin surveillance of non-cleared workers at the start of SCIF construction.
 - (2) Upon completion of all work, the CST shall clear and secure the areas for which they are responsible prior to turning control over to the CAGs.
 - f) In Category I and II countries the following shall apply:
 - (1) The CST shall begin surveillance of non-cleared workers at the start of construction of public access or administrative areas adjacent to the SCIF, or SCIF construction, whichever comes first.
 - (2) Upon completion of all work, the CST shall clear and secure the areas for which the CST is responsible prior to turning over control to the CAGs.
3. CAG Requirements and Responsibilities
- a) Possesses a U.S. TOP SECRET clearance.
 - b) Performs access control functions at all vehicle and pedestrian entrances to the site except as otherwise noted in the CSP.
 - (1) Screens all non-cleared workers, vehicles, and equipment entering or exiting the site.
 - (2) Uses walk-through and/or hand-held metal detectors or other means approved by the RSO or designee to deny introduction of prohibited materials such as explosives, weapons, electronic devices, or other items as specified by the RSO or designee.
 - (3) Conducts random inspections of site areas to ensure no prohibited materials have been brought on to the site. All suspicious materials or incidents shall be brought to the attention of the SSM.
 - c) In Category III countries, CAGs shall be assigned to protect the site and surrounding area at the start of construction of the SCIF or commencement of operations of the SSA.
 - d) In Category I and II countries, CAGs shall be assigned to protect the site and surrounding area at the start of construction of the SCIF, areas adjacent to the SCIF, or commencement of operations of the SSA.
 - e) For existing SCIFs, TOP SECRET/SCI-indoctrinated U.S. citizen guards are not required to control access to the site or SSA provided the following apply:
 - (1) TOP SECRET/SCI-indoctrinated U.S. citizens are present on a 24-hour basis in the SCIF or the SCIF can be properly secured and alarmed.
 - (2) Prescribed post security resources are in place to monitor the SSA.

F. Construction Security Requirements

1. Prior to awarding a construction contract, a CSP for each project shall be developed by the SSM and approved by DoS/DS and DoS/OBO and the tenant AO.
2. Construction plans and all related documents shall be handled and protected in accordance with the CSP.
3. For SCIF renovation projects, barriers shall be installed to segregate construction workers from operational activities. These barriers will provide protection against unauthorized access and visual observation. Specific guidance shall be contained in the CSP.
4. When expanding existing SCIF space into areas not controlled at the SECRET level, maximum demolition of the new SCIF area is required.
5. For areas controlled at the SECRET level that meet OSPB pre-conditions, or when performing renovations inside existing SCIF space, maximum demolition is not required.
6. All requirements for demolition shall be documented in the CSP.
7. Periodic security inspections shall be conducted by the SSM or designee for the duration of the project to ensure compliance with construction design and security standards.
8. Citizenship and Clearance Requirements for SCIF Construction Personnel
 - a) Use of workers from countries identified as critical for Technical or Human Intelligence threat, or listed on the DoS Prohibited Countries Matrix, is prohibited.
 - b) General construction and finish work is defined by OSPB standards.
 - c) General construction of SCIFs shall be performed using U.S. citizens and U.S. firms. Use of foreign national citizens or firms to perform general construction of SCIFs may be authorized in accordance with OSPB standards. In this situation, the CSP shall prescribe mitigating strategies to counter security and counterintelligence threats.
 - d) SCIF finish work shall be accomplished by appropriately cleared personnel as directed by OSPB standards for CAA construction.
 - e) All non-cleared construction personnel shall provide the SSM with biographical data (full name, current address, SSN, DPOB, proof of citizenship, etc.), and fingerprint cards as allowed by local laws prior to the start of construction/renovation.
 - f) Two forms of I-9 identification are required to verify U.S. persons.
 - g) Whenever host nation agreements make this information not available, it shall be addressed in the CSP.
 - h) When non-U.S. citizens are authorized, the following shall apply:
 - (1) The SSM shall conduct, through liaison channels, checks of criminal and subversive files, local and national; and host country agencies, consistent with host country laws.
 - (2) Checks shall also be conducted of CIA indices through the country's DNI representative and appropriate in-theater U.S. military authorities.

(3) Access to sites shall be denied or withdrawn if adverse security, CI, or criminal activity is revealed. The SSM shall notify the AO and RSO when access to the site is denied or withdrawn.

(4) For existing facilities, the following apply:

(a) Non-cleared workers monitored by CSTs may perform maximum demolition for conversion of non-CAA to SCIF. Debris removal by non-cleared workers must be monitored at a minimum by cleared U. S. citizen escorts.

(b) TOP SECRET-cleared U.S. citizens must perform maximum demolition within, or penetrating the perimeter of, an existing SCIF.

(c) TOP SECRET-cleared U.S. citizens shall be used to renovate SCIF space.

(d) SECRET-cleared individuals may perform the work when escorted by TOP SECRET-cleared U.S. citizens.

(e) SCI-indoctrinated escorts are not required when the existing SCIF has been sanitized or a barrier has been constructed to separate the operational areas from the areas identified for construction.

i) Prior to initial access to the site, all construction personnel shall receive a security briefing by the SSM or designee on the security procedures to be followed.

j) If a construction worker leaves the project under unusual circumstances, the SSM shall document the occurrence and notify the RSO and tenant AO. The RSO shall review for CI concerns.

k) The SSM may require cleared escorts or CSTs for non-cleared workers performing work exterior to the SCIF that may affect SCIF security.

l) The ratio of escort personnel to construction personnel shall be determined by the SSM on a case-by-case basis and documented in the CSP. Prior to assuming escort duties, all escorts shall receive a briefing regarding their responsibilities.

9. Access Control of Construction Sites

a) Access control to the construction site and the use of badges are required.

b) Guards are required for SCIF construction outside the U.S.

c) All site control measures used shall be documented in the CSP.

d) The following site control measures should be considered:

(1) Identity verification.

(2) Random searches at site entry and exit points.

(3) Signs, in English and other appropriate languages, at all entry points listing prohibited and restricted items (e.g., cameras, firearms, explosives, drugs, etc.).

(4) Physical security barriers to deny unauthorized access.

(5) Vehicle inspections.

10. Local Guards

- a) Local guards, supervised by CAGs and using procedures established by the RSO and documented in the CSP, may search all non-cleared personnel, bags, toolboxes, packages, etc., each time they enter or exit the site.
- b) Use of non-cleared U.S. guards or non-U.S. guards to control access to the site or secure storage area (SSA) requires the prior approval of the RSO. A SECRET-cleared U.S. citizen must supervise non-cleared or non-U.S. guards. Non-cleared or non-U.S. guards shall not have unescorted access to the site.

G. Procurement of Construction Materials

1. General Standards

- a) These standards apply to construction materials used in SCIF construction under COM authority. These standards do not apply to installations on a roof contiguous to the SCIF provided there is no SCIF penetration.
- b) Procurements shall be in accordance with Federal Acquisition Regulations.
- c) In exceptional circumstances, SSMs may deviate from procurement standards with a waiver; such deviation shall be noted in the CSP.
- d) For building construction projects in Category III countries, cleared U.S. citizens may randomly select up to 35% of building materials from non-specific general construction materials for SCIF construction. Random selection may exceed 35% only if materials can be individually inspected.
- e) For building construction projects in Category I and II countries, cleared U.S. citizens may randomly select up to 25% of building materials from non-specific general construction materials for SCIF construction. Random selection may exceed 25% only if materials can be individually inspected.
- f) All such materials must be selected immediately upon receipt of the shipment and transported to secure storage.
- g) Procurement of materials from host or third party countries identified in the SETL as critical for technical intelligence, or listed on the DoS Prohibited Countries Matrix, is prohibited.

2. Inspectable Materials Specifically Destined for SCIF Construction

- a) Inspectable materials specifically destined for SCIF construction may be procured from U.S. third-country or local suppliers without security restrictions.
- b) All inspectable materials specifically destined for SCIF construction procured in host and third party countries or shipped to site in an unsecured manner from the U.S. shall be inspected using a DoS/DS-approved method and then moved to an SSA.
- c) All inspectable material selected from stock stored outside of the SSA shall be inspected using DoS/DS-approved methods prior to use in SCIF construction.

3. Non-Inspectable Materials Specifically Destined for SCIF Construction

- a) Non-inspectable materials specifically destined for SCIF construction shall be procured from U.S. suppliers with subsequent secure transportation to the SSA at the construction site.
- b) On an exceptional basis, non-inspectable materials may be procured in a host or third party country if randomly selected by cleared U.S. citizens.
 - (1) Materials shall be randomly chosen from available suppliers (typically three or more) without advance notice to, or referral from, the selected supplier and with no reference of the intended use of material in a SCIF.
 - (2) Such selections shall be made from available shelf stock, brought immediately under personal control of a cleared U.S. citizen, and transported securely to an SSA.
 - (3) Procurement officials should be circumspect about continually purchasing non-inspectable materials from the same local suppliers and establishing a pattern that could be reasonably discernible by hostile intelligence services, foreign national staff, and suppliers.

H. Secure Transportation for Construction Material

1. Inspectable Materials Specifically Destined for SCIF Construction
 - a) Inspectable materials do not require secure transportation but shall be inspected using procedures approved by the DoS/DS prior to use in the SCIF.
 - b) Once inspected, all inspectable items shall be stored in an SSA.
 - c) Materials may be utilized within the SCIF without inspection if securely procured, securely shipped, and stored in a secure environment.
2. Non-inspectable Materials Specifically Destined for SCIF Construction
 - a) Non-inspectable material includes inspectable materials when the site does not possess the capability to inspect by Do/DS-approved means.
 - b) Non-inspectable materials shall be securely procured and shipped to site by secure transportation from the U.S., a secure logistics facility, or low threat third party country using one of the following secure methods:
 - (1) Securely packaged or containerized and under the 24-hour control of an approved courier or escort officer. (Escorted shipments shall be considered compromised if physical custody or direct visual observation is lost by the escort officer during transit. Non-inspectable materials that are confirmed compromised or suspected of compromise shall not be used in a SCIF.)
 - (2) Securely shipped using approved transit security technical safeguards capable of detecting evidence of tampering or compromise. (An unescorted container protected by technical means (“trapped”) is considered compromised if evidence of tampering of the protective technology is discovered, or if an unacceptable deviation from the approved transit security plan occurs. Non-inspectable

materials that are confirmed compromised or suspected of compromise shall not be used in a SCIF.)

(3) Non-inspectable materials shall be shipped using the following surface and air carriers in order of preference:

- (a) U.S. Military
- (b) U.S. Flag Carriers
- (c) Foreign Flag Carriers

I. Secure Storage of Construction Material

1. Upon arrival, all inspected and securely shipped materials shall be placed in the SSA until required for installation.
2. An SSA shall be established and maintained for the secure storage of all SCIF construction material and equipment. It is characterized by true floor to true ceiling, slab-to-slab construction of some substantial material and a solid wood-core or steel-clad door equipped with a DoS/DS-approved security lock.
3. Alternative SSA's may include a shipping container located within a secure perimeter that is locked, alarmed, and monitored, or a room or outside location enclosed by a secure perimeter that is under direct observation by a SECRET-cleared U.S. citizen.
4. The SSA shall be under the control of CAGs or other U.S. citizens holding at least U.S. SECRET clearances.
5. Supplemental security requirements for SSAs shall be set forth in the CSP and may vary depending on the location and/or threat to the construction site.

J. Technical Security

1. TEMPEST countermeasures shall be pre-engineered into the building.
2. A TSCM inspection shall be required in Category I countries for new SCIF construction or significant renovations (50% or more of SCIF replacement cost).
3. A TSCM inspection may be required by the AO in Category II or III countries for new SCIF construction or significant renovations (50% or more of SCIF replacement cost).
4. A TSCM inspection, conducted at the completion of construction, shall be required if uncontrolled space is converted (maximum demolition) to new SCIF space.
5. When a TSCM inspection is not conducted, a mitigation strategy based on a physical security inspection that identifies preventative and corrective countermeasures shall be developed to address any technical security concerns.

K. Interim Accreditations

1. Upon completion of a successful inspection, the respective agency's AO may issue an Interim Accreditation pending receipt of required documentation.
2. If documentation is complete, AOs may issue an Interim Accreditation pending the final inspection.

Chapter 6. Temporary, Airborne, and Shipboard SCIFs

A. Applicability

1. General Information

- a) This chapter covers all SCIFs designed to be temporary or such as those at sites for contingency operations, emergency operations, and tactical military operations. This chapter does not apply to temporary SCIFs established or operated within or on U.S. diplomatic facilities/compounds; see Chapter 5 for applicable guidance.
- b) These standards apply to the following:
 - (1) All ground-based temporary SCIFs (T-SCIFs), including those on mobile platforms (e.g., trucks and trailers).
 - (2) SCIFs aboard aircraft.
 - (3) SCIFs aboard surface and sub-surface vessels.
- c) When employing T-SCIFs, a risk management approach shall be used that balances the operational mission and the protection of SCI.

2. Accreditation

- a) Accreditation for the use of T-SCIFs shall not exceed one year without mission justification and approval by the AO.
- b) When the T-SCIF owner determines that a T-SCIF is no longer required, the withdrawal of accreditation shall be initiated by the SSO/Contractor Special Security Officer (CSSO).
 - (1) Upon notification, the AO will issue appropriate SCI withdrawal correspondence.
 - (2) The AO or appointed representative will conduct a close-out inspection of the facility to ensure that all SCI material has been removed.

B. Ground-Based T-SCIFs

1. T-SCIF Structures and Activation

- a) Ground-based T-SCIFs may be established in hardened structures (e.g., buildings, bunkers) or semi-permanent structures (e.g., truck-mounted or towed military shelters, prefabricated buildings, tents).
- b) Permanent-type hardened structures shall be used to the greatest extent possible for T-SCIFs.
- c) Prior to T-SCIF activation, the AO may require submission of a standard fixed facility checklist or a T-SCIF checklist produced before or after a deployment.

2. SCI Storage and Destruction

- a) Under field or combat conditions, open storage of SCI media and materials requires a continuous presence by SCI-indoctrinated personnel.
- b) Under field or combat conditions every effort shall be made to obtain from any available host command necessary support for the storage and protection of SCI (e.g., security containers, generators, guards, weapons, etc.).
- c) The quantity of SCI material within a T-SCIF shall be limited, to the extent possible, to an amount consistent with operational needs.
- d) All SCI shall be stored in GSA-approved security containers.
- e) The AO may approve exceptions to the storage of SCI material in GSA-approved storage containers for a specified period of time.
- f) When no longer needed, SCI material shall be destroyed by means approved by the AO.

3. Security Requirements

- a) T-SCIF security features shall provide acoustical, visual, and surreptitious entry protection.
- b) A TSCM inspection shall be requested for any structure proposed for T-SCIF use if the space was previously occupied by a non-U.S. element. It is the AO's responsibility to evaluate operating the SCIF prior to TSCM inspection and formally assume all risk associated with early operation.
- c) When possible, T-SCIFs shall be established within the perimeters of U.S.-controlled areas or compounds.
- d) If a U.S.-controlled area or compound is not available, the T-SCIF shall be located within an area that affords the greatest degree of protection against surreptitious or forced entry.
- e) When a T-SCIF is in operation, the perimeter of its immediate area shall be observed and protected by U.S. guards with U.S. SECRET clearances. Guards shall be equipped with emergency communication devices and, if necessary, with weapons.
- f) During non-operational hours, the T-SCIF shall be provided security protection in accordance with AO guidelines.
- g) The T-SCIF shall have only one entrance which shall be controlled during hours of operation by an SCI-indoctrinated person using an access roster.
- h) Unclassified telecommunications equipment shall meet the requirements outlined in Chapter 10 to the greatest extent practical.
- i) Telephones obtained in a foreign country shall not be used within a T-SCIF.
- j) Cables and wires penetrating the T-SCIF perimeter shall be protected. The AO may require inspections and routing of cables and wiring through protective distribution systems or may require other countermeasures.

- k) AO-approved emergency destruction and evacuation plans shall be developed and rehearsed periodically by all personnel assigned to the T-SCIF; the results of the rehearsal drills shall be documented.
- l) When in transit, ground-based and mobile (e.g., truck-mounted, towed military shelters) T-SCIFs containing unsecured and non-encrypted SCI shall be accompanied by a U.S. TOP SECRET-cleared individual with SCI access approval(s).
- m) During movement, T-SCIF structures shall be secured with GSA-approved locking devices and equipped with tamper-evident seals.
- n) When in transit, hardened T-SCIFs having no open storage of SCI may be monitored by a U.S. SECRET-cleared individual.
- o) Hardened T-SCIFs shall be designed with TEMPEST countermeasures as identified by the CTTA. The AO, in collaboration with the CTTA, shall provide red/black separation and “protected distribution” guidance for field installation in accordance with CNSSAM TEMPEST 1/13 and CNSSI 7003.
- p) When a T-SCIF is no longer required, the responsible SCI security official shall conduct a thorough facility inspection to ensure all SCI material has been removed.

C. Permanent and Tactical SCIFs Aboard Aircraft

1. The Aircraft Facility Checklist (see Forms & Plans) will be used for permanent SCIFs aboard aircraft.
2. The AO may determine that an Aircraft Facility Checklist may not be required for tactical SCIFs aboard aircraft if the following information is provided:
 - a) Name of aircraft (tail number)/airborne T-SCIF.
 - b) Major command/organization.
 - c) ID number of parent SCIF, if applicable.
 - d) Location T-SCIF deployed from and date of deployment.
 - e) Location T-SCIF deployed to and date of deployment.
 - f) SCI compartment(s) involved in T-SCIF operations.
 - g) Time period for T-SCIF operations.
 - h) Name of exercise or operation.
 - i) Points of contact (responsible officers).
 - j) Type of aircraft and area to be accredited as a T-SCIF.
 - k) Description of security measures for entire period of T-SCIF use (standard operating procedures).
 - l) Additional comments to add clarification.

Chapter 6
Temporary, Airborne, and Shipboard SCIFs

3. Security Requirements for Aircraft when Operating in Support of Missions Involving SCI Material

- a) SCIF location shall be identified by aircraft tail number.
- b) Access to the aircraft interior shall be controlled at all times by SCI-indoctrinated personnel.
- c) There are no unique physical security construction standards for SCIFs aboard aircraft.
- d) Accreditation, such as that from the Defense Courier Service, is not required for aircraft used solely to transport SCI material between airfields.
- e) When all personnel on an aircraft are not briefed on every SCI compartment aboard, procedural methods or physical barriers shall be employed to isolate compartments of the SCI.
- f) When an aircraft T-SCIF is no longer required, the responsible SCI security official shall conduct an inspection of the aircraft to ensure all SCI material has been removed.

4. SCI Storage and Destruction

- a) SCI materials shall be encrypted or secured in an AO-approved security container.
- b) When no longer needed, SCI materials shall be destroyed by means approved by the AO.
- c) Following an unscheduled landing in U.S.-controlled or non-hostile territory, the senior SCI-indoctrinated person shall retain control of the SCI material until approved storage arrangements can be effected through a local Special Security Officer or SCI-indoctrinated official.
- d) Prior to an unscheduled landing in unfriendly or hostile territory, every reasonable effort shall be made to destroy unencrypted SCI material and communications security equipment in accordance with the emergency destruction plan.
- e) If the aircraft is stationary, in the absence of SCI-indoctrinated personnel, all SCI information shall be encrypted or removed and stored in an alternative accredited SCIF or location approved by the AO.
- f) Emergency destruction plans for SCI material shall be developed, approved by the AO, and rehearsed periodically by all personnel assigned to the aircraft; rehearsal results shall be documented.

5. Additional Security Requirements for Stationary Aircraft

- a) The aircraft shall be parked within a controlled area that affords the greatest protection against surreptitious or forced entry.
- b) In the absence of SCI-indoctrinated personnel, all SCI information shall be encrypted or removed and stored in an alternative accredited SCIF or location approved by the AO.

c) If the aircraft cannot be positioned within a U.S.-controlled area, the SCI is not encrypted, and removal of the SCI is not possible, then the following measures must be taken:

- (1) SCI-indoctrinated personnel shall remain with the aircraft.
- (2) A guard force that can control the perimeter of the aircraft shall be deployed, unless infeasible. The guards shall possess U.S. SECRET clearances and be armed and equipped with emergency communication devices.

d) If the aircraft is located within a U.S.-controlled area, the SCI is not encrypted, and removal of SCI is not possible then, the following measures shall be taken:

- (1) The AO may mitigate the requirement for SCI-indoctrinated personnel provided the aircraft is equipped with, or stored within a structure equipped with, an intrusion detection system approved by the AO.
- (2) All aircraft hatches and doors shall be secured with AO-approved locks and tamper-evident seals.
- (3) A guard force must be available to respond to an alarm within five minutes.
- (4) Guards shall possess U.S. SECRET clearances and be armed and equipped with emergency communication devices.
- (5) If a cleared U.S. guard force is not available, the AO may approve other mitigation measures.

D. Permanent and Tactical SCIFs on Surface or Subsurface Vessels

1. Permanent shipboard SCIFs shall consist of any area aboard a vessel where SCI is processed, stored, or discussed.
2. The Shipboard Checklist (see Forms & Plans) will be used for permanent SCIFs. The AO may determine that this checklist may not be required providing the below information is available:
 - a) Name of vessel/hull number.
 - b) Major command/organization.
 - c) ID number of parent SCIF, if applicable.
 - d) Location SCIF deployed from and date of deployment.
 - e) Location SCIF deployed to and date of deployment.
 - f) SCI compartment(s) and sub-compartments involved in SCIF operations.
 - g) Name of exercise or operation.
 - h) Points of contact (responsible officers).
 - i) Description of security measures for entire period of SCIF use (standard operating procedures).

- j) Additional comments to add clarification.
3. Security Requirements for Permanent SCIFs
- a) The perimeter (walls, floors, and ceiling) shall be fabricated of structural bulkheads comprised of standard shipboard/submarine construction materials.
 - b) Elements of the perimeter shall be fully braced and welded or bonded in place.
 - c) Doors shall conform to the following requirements:
 - (1) Perimeter doors and emergency exit(s) shall be constructed of standard shipboard materials and shall be mounted in a frame, braced and welded or bonded in place in a manner commensurate with the structural characteristics of the bulkhead, deck, or overhead.
 - (2) The primary entry door shall be equipped with a GSA-approved combination lock and an access control device.
 - (3) If the door is in a bulkhead that is part of an airtight perimeter, the airtight integrity may be maintained by co-locating the door with the metal joiner door, or by adding a vestibule.
 - (4) Metal joiner doors shall be equipped with a combination lock that meets specification FF-L-2740A and with an access control device approved by the AO.
 - (5) Doors shall be constructed in a manner that will preclude unauthorized removal of hinge pins and anchor bolts, and obstruct access to lock-in bolts between the door and frame.
 - (6) Doorways or similar openings that allow visual access to the SCIF shall be screened or curtained.
 - d) No damage control fittings or cables shall be located within, or pass through, the SCIF. This does not apply to smoke dampers or other life-safety devices that are operated by personnel within the space during working hours.
 - e) Removable hatches and deck plates less than 10 square feet that are secured by exposed nuts and bolts (external to the SCIF) shall be secured with a high security padlock (unless their weight makes this unreasonable). Padlock keys shall be stored in a security container located within the SCIF.
 - f) Vents, ducts, and similar openings with a cross-sectional measurement greater than 96 inches shall be protected by a fixed barrier or security grill. (This requirement is not applicable to through-ducts that do not open into the SCIF.)
 - (1) Grills shall be fabricated of steel or aluminum grating or bars with a thickness equal to the perimeter barrier.
 - (2) If a grating is used, bridge center-to-center measurements will not exceed 1.5 inches by 4 inches.
 - (3) Bars shall be mounted in a grid pattern, six-inches on center.
 - (4) The grating or bars shall be welded into place.

Chapter 6
Temporary, Airborne, and Shipboard SCIFs

- g) Construction of the SCIF perimeter shall afford adequate sound attenuation. Air handling units and ducts may require baffles if SCIF discussions can be overhead in adjacent areas.
- h) The SCIF shall be equipped with an AO-approved intrusion detection system (IDS) or other countermeasures if SCI-indoctrinated personnel cannot continuously occupy the area.
- i) Passing scuttles and windows should not be installed between the SCIF and any other space on the ship. If installed, they shall be secured on the inside of the SCIF.
- j) All SCI cryptographic and processing equipment shall be located within the SCIF.
- k) Unclassified telecommunications shall meet the requirements outlined in Chapter 11, to the greatest extent practical.
- l) Sound-powered telephones will not be permitted in the SCIF without additional mitigations determined by the AO. If a deviation is granted, sound-powered telephones located within the SCIF and connecting to locations outside the SCIF shall comply with the following:
 - (1) Telephone cables shall not break out to jack-boxes, switchboards, or telephone sets other than at designated stations. Cables shall not be shared with any circuit other than call or signal systems associated with the SCIF circuit.
 - (2) Telephone cables shall be equipped with a selector switch located at the controlling station and shall be capable of disconnecting all stations, selecting any one station, and disconnecting the remaining stations.
 - (3) Sound-powered telephones not equipped with a selector switch shall have a positive disconnect device attached to the telephone circuit.
 - (4) Within any SCIF, sound-powered telephones not used for passing SCI information shall have a warning sign prominently affixed indicating the restriction.
 - (5) A call or signal system shall be provided. Call signal station, type ID/D, shall provide an in-line disconnect to prevent a loudspeaker from functioning as a microphone.
- m) The approval of the AO is required for unencrypted, internal, communication-announcing systems that pass through the SCIF perimeter.
- n) Intercommunications-type announcing systems installed within an SCIF shall meet the following standards:
 - (1) The system shall operate only in the push-to-talk mode.
 - (2) Receive elements shall be equipped with a local buffer amplifier to prevent loudspeakers or earphones from functioning as microphones.
 - (3) Except as specified, radio transmission capability for plain radio-telephone (excluding secure voice) will not be connected.
 - (4) Cable conductors assigned to the transmission of plain language radio-telephone will be connected to ground at each end of the cable.

Chapter 6 Temporary, Airborne, and Shipboard SCIFs

- (5) A warning sign will be posted that indicates the system may not be used to pass SCI.
 - (6) Unencrypted internal communication systems that pass through the SCIF perimeter shall be in grounded ferrous conduit.
 - o) Commercial intercommunication equipment shall not be installed within a SCIF without prior AO approval.
 - p) Loudspeakers used on general announcing systems shall be equipped with a one-way buffer amplifier to protect against microphonic responses.
 - q) Pneumatic tube systems shall not be installed within the SCIF. The following safeguards apply to existing systems on older ships:
 - (1) Covers shall be locked at both ends with an AO-approved lock. Keys shall be stored within an approved security container within the SCIF.
 - (2) The system shall have the capability to maintain the pressure or vacuum and the capability to lock in the secure position at the initiating end.
 - (3) There shall be a direct voice communications link between both ends to confirm the transportation and receipt of passing cartridges.
 - (4) Cartridges passing SCI material shall have a distinctive color.
 - (5) Pneumatic tubes shall be visually inspectable along their entire length.
 - (6) The CTTA shall conduct a TEMPEST countermeasures inspection and shall recommend safeguards to limit compromising emanations. TEMPEST safeguards should be pre-engineered into platforms to the greatest extent possible.
4. General Requirements for T-SCIFs
- a) SCIFs on sub-surface vessels shall be accredited as T-SCIFs.
 - b) T-SCIFs aboard a vessel include portable platforms or containers temporarily placed within ship space such as embarked Portable Shipboard Collection Vans.
 - c) T-SCIFs shall be occupied by an SCI-indoctrinated person at all times unless the facility is protected by a GSA-approved lock, an approved intrusion detection system, and a response capability or other countermeasures approved by the AO.
5. Security Requirements for T-SCIFs
- a) Overall T-SCIF construction standards shall be the same as those used for permanent shipboard SCIFs.
 - b) Vents, ducts, and similar openings shall be constructed to the same standards as those used for a shipboard SCIF.
 - c) SCI materials shall be destroyed by means approved by the AO when no longer needed.
 - d) AO-approved emergency destruction plans shall be rehearsed periodically by all personnel assigned to the T-SCIF and the rehearsals documented.

Chapter 6
Temporary, Airborne, and Shipboard SCIFs

- e) Unclassified telecommunications shall meet the requirements for a shipboard SCIF, to the greatest extent practical.
 - f) When the T-SCIF is no longer required, the responsible SCI security official shall conduct a closing inspection of the T-SCIF to ensure all SCI material has been removed.
 - g) The CTTA shall conduct a TEMPEST countermeasures inspection and shall recommend safeguards to limit compromising emanations. TEMPEST safeguards should be pre-engineered into platforms to the greatest extent possible.
6. Additional Security Standards for Mobile Platforms or Containers
- a) Construction of the perimeter must be of sufficient strength to reveal evidence of physical penetration (except for required antenna cables and power lines).
 - b) Doors must fit securely and be equipped with a locking device that can be locked from the inside and outside.
7. SCI Storage and Destruction
- a) SCI material shall be stored in a GSA-approved security container that is welded or otherwise permanently secured to the structural deck.
 - b) When no longer needed, SCI materials shall be destroyed by means approved by the AO.
 - c) AO-approved emergency destruction and evacuation plans shall be developed and rehearsed periodically by all personnel assigned to the SCIF and the rehearsals shall be documented.

This page intentionally left blank.

Chapter 7. Intrusion Detection Systems (IDS)

A. Specifications and Implementation Requirements

1. General SCIF IDS Requirements

- a) SCIFs shall be protected by IDS when not occupied.
- b) Interior areas of a SCIF through which reasonable access could be gained, including walls common to areas not protected at the SCI level, shall be protected by IDS. However, these adjacent areas do not need IDS protection if the AO determines that a facility's security programs consist of layered and complementary controls sufficient to deter and detect unauthorized entry and movement.
- c) Doors without access control systems and that are not under constant visual observation shall be continuously monitored by the IDS.
- d) If any component of the IDS is disrupted to the extent the system no longer provides essential monitoring service (e.g., loss of line security, inoperable Intrusion Detection Equipment (IDE), or loss of power), SCI-indoctrinated personnel shall physically occupy the SCIF until the system is returned to normal operation. As an alternative, the outside SCIF perimeter may be continuously monitored by a response or guard force.
- e) IDS failure shall be addressed in the SCIF emergency plan.

2. System Requirements

- a) IDS installation related components and monitoring stations shall comply with Underwriters Laboratories (UL) Standard for National Industrial Security Systems for the Protection of Classified Material, UL 2050.
- b) Installation shall comply with an Extent 3 installation as referenced in UL 2050.
- c) Systems developed and used exclusively by the USG do not require UL certification, but shall nonetheless comply with an Extent 3 installation as referenced in UL 2050.
- d) Areas of a SCIF through which reasonable access could be gained, including walls common to areas not protected at the SCI level, shall be protected by IDS consisting of UL 639 listed motion sensors and UL 634 listed High Security Switches (HSS) that meet UL Level II requirements and/or other AO-approved equivalent sensors. All new SCIF accreditations shall use UL Level II HSS. Existing UL Level I HSS are authorized until major IDS modifications/upgrades are made.
- e) IDE cabling that extends beyond the SCIF perimeter shall employ Encrypted Line Security or be installed in a closed and sealed metal conveyance defined as a pipe, tube or the like constructed of ferrous Electrical Metallic Tubing (EMT), ferrous pipe conduit or ferrous rigid sheet metal ducting. All joints and connections shall be permanently sealed completely around all surfaces (e.g. welding, epoxy, fusion, etc.). Set screw shall not be used. The seal shall provide a continuous bond between the

components of the conveyance. If a service or pull box must be utilized, it must be secured with a GSA approved combination padlock or AO approved key lock.

f) SCIFs that share common or contiguous perimeter and support the same IC Element, or have an established Co-Use-Agreement (CUA), may have the Premise Control Unit (PCU) programmed into multiple logical units or partitions, of the same PCU, that function as individual control units for the intrusion detection system installed in multiple areas or rooms operated independently of one another. All conditions of compliance that apply to a PCU and IDS apply equally to the partitions of the PCU. The PCU shall be independent of IDS safeguarding non-UL 2050 certified areas.

g) If a monitoring station is responsible for more than one IDS, there shall be an audible and visible annunciation for each IDS.

h) IDS's shall be separate from, and independent of, fire, smoke, radon, water, and other systems.

i) If the IDS incorporates an access control system (ACS), notifications from the ACS shall be subordinate in priority to IDS alarms.

j) System key variables and passwords shall be protected and restricted to U.S. SCI-indoctrinated personnel.

k) IDS technical drawings, installation instructions, specifications, etc., shall be restricted as determined by the AO and documented in the CSP.

l) Systems shall not include audio or video monitoring without the application of appropriate countermeasures and AO approval.

m) Monitoring systems containing auto-reset features shall have this feature disabled.

n) Alarm activations shall remain displayed locally until cleared by an authorized SCI-cleared individual.

o) The AO shall approve all system plans. Final system acceptance testing shall be included as part of the SCIF accreditation package.

p) False alarms shall not exceed one alarm per 30-day period per IDS partition. False alarms are any alarm signal transmitted in the absence of a confirmed intrusion that is caused by changes in the environment, equipment malfunction or electrical disturbances. If false alarms exceed this requirement, a technical evaluation of the system shall be conducted to determine the cause, repaired or resolved, and documented.

3. System Components

a) Sensors

(1) All system sensors shall be located within the SCIF, except as noted in 3.a.(2) below.

(2) With AO approval, sensors external to the SCIF perimeter may be installed in accordance with paragraph A.2.e.

- (3) Failed sensors shall cause immediate and continuous alarm activation until the failure is investigated and corrected by procedures as documented in the SCIF SOP or Emergency Action Plan.
- (4) Dual technology sensors are authorized when each technology transmits alarm conditions independent of the other technology.
- (5) A sufficient number of motion detection sensors shall be installed to meet the requirements of paragraph A.2.d or shall be approved by the AO. However, for facilities outside the U.S. and in Category I and II countries, motion detection sensors above false ceilings or below false floors may be required by the AO.
- (6) When the primary entrance door employs a delay to allow for changing the system mode of access, the delay shall not exceed 30 seconds.
- (7) SCIF perimeter doors shall be protected by an HSS and a motion detection sensor.
- (8) Emergency exit doors shall be alarmed and monitored 24 hours per day.

b) Premise Control Units (PCUs)

- (1) PCUs shall be located within a SCIF and only SCIF personnel may initiate changes in access modes.
- (2) Operation of the access/secure switch shall be restricted by using a device or procedure that validates authorized use.
- (3) Cabling between all sensors and the PCU shall be dedicated to the system, be contained within the SCIF, and shall comply with national and local electric codes and Committee for National Security Systems (CNSS) standards. If the wiring cannot be contained within the SCIF, such cabling shall meet the requirements for External Transmission Line Security 3.b.(10) below.
- (4) Alarm status shall be continuously displayed with an alphanumeric display at the PCU and/or monitoring station.
- (5) Every effort shall be made to design and install the alarm-monitoring panel in a location that prevents observation by unauthorized persons.
- (6) The monitoring station or PCU shall identify and display activated sensors.
- (7) Immediate and continuous alarm annunciations shall occur for the following conditions.
 - (a) Intrusion Detection
 - (b) Failed Sensor
 - (c) Tamper Detection
 - (d) Maintenance Mode (a maintenance message displayed in place of an alarm)
 - (e) IDE Sensor Points shunted or masked during maintenance mode
- (8) A change in power status (AC or backup) shall be indicated locally and at the monitoring station.

(9) All system events shall be reset by authorized SCI-indoctrinated personnel after an inspection of the SCIF and a determination for the cause of the alarm. Any auto-alarm reset feature of the IDS shall be disabled.

(10) IDS transmission lines leaving the SCIF to the monitoring station, must meet National Institute of Standards and Technology, Federal Information Processing Standards (FIPS) for certified encrypted lines. The FIPS standard employed must be noted on the UL 2050/CRZH Certificate or other certificate employed. PCUs certified under UL 1610 must meet FIPS 197 or FIPS 140-2 encryption certification and methods. For PCUs certified under UL1076, only FIPS 140-2 is the acceptable encryption certification and method. Alternative methods shall be approved by the AO and noted on the IDS Certificate

(11) The SCI cleared IDS Administrator(s) shall change maintenance and master profiles, PINs or passcodes from their default settings to a unique PIN or passcode.

c) Integrated IDS and Remote Terminal Access.

(1) US government LAN or WAN requires the AO's Chief Information Officer (CIO) to be consulted before connecting an IDS. The system hosting the IDS shall be issued Authority to Operate (ATO) by the agency CIO, following the FISMA Risk Management Framework as outlined in NIST SP 800-53.

(2) For IDS that have been integrated into a networked system (local area network (LAN) or wide area network (WAN)), the requirements below shall be met.

(a) IDS System software shall be installed on a host computing device that is logically and physically restricted to corporate/government security elements cleared to the SCI level. The host device shall be located in a Physically Protected Space, which is defined as a locked room with walls, floor and ceiling that are fixed in place forming a solid physical boundary to which only SCI-cleared personnel have access. If uncleared personnel or personnel with less than SCI indoctrination require access to this space, they shall be escorted by authorized SCI-cleared personnel. The door(s) shall use Commercial Grade 1 hardware fitted with high security key cylinder(s) in compliance with UL 437. This room will be protected by a UL Extent 3 burglar alarm system and access control unless manned 24 hours.

(b) All system components and equipment shall be isolated in a manner that may include, but are not limited to firewalls, Virtual Private Networks, Virtual Routing Tables, Application Level security mechanisms or similar enhancements, that are configured to allow secure and private data transfers only between the PCU, host computer, remote terminal and monitoring station.

- (c) If any component of the IDS is remotely programmable, continuous network monitoring is required. Continuous network monitoring includes auditing and reporting of network intrusion detection and prevention systems used in A.3.c.2.b.
- (d) A secondary communication path may be utilized to augment an existing data communication link to reduce investigations of data communication failures of less than five minute duration. The supervision provided by the secondary communication path shall be equivalent to that of the primary communication path. The secondary communications path may only be wireless if approved by the AO in consultation with the CTTA and/or the appropriate technical authority.
- (e) A unique user ID and password is required for each individual granted access to the system host computing devices or remote terminal. Passwords shall be a minimum of twelve characters consisting of alpha, numeric, and special characters, and shall be changed every six months or utilize US Government Personal Identity Verification (PIV) Card or Common Access Card (CAC) with two factor certificate authentication.
- (f) Individuals with IDS administrative access shall immediately notify the AO or designee of any unauthorized modifications.
- (g) All transmissions of system information over the LAN/WAN shall be encrypted using National Institute of Standards and Technology (NIST) FIPS 140-2, VPN, or closed and sealed conveyance (see A.2.e). FIPS-197 (AES) may be used with AO approval.
- (h) Remote System terminals shall:
- Utilize role based user permissions (e.g. Super User, SO, Guard) as approved by the AO. USG installations shall be in compliance with paragraph 7.A.3.c.1 Prohibit Non SCI Cleared personnel from modifying the IDS or ACS.
 - Require an independent user ID and password in addition to the host login requirements. Requirements for IDS Systems Software Passwords shall be: a unique user ID and password for each individual granted access to the remote terminal. Passwords shall be a minimum of twelve characters consisting of alpha, numeric, and special characters and shall be changed every six months or utilize US Government Personal Identity Verification (PIV) Card or Common Access Card (CAC) with two factor certificate authentication if supported by the application.

- Host systems shall log and monitor failed login attempts. All remote sessions shall be documented and accessible to AO upon request.
- All Host systems and PCUs shall be patched and maintained to implement current firmware and security updates. USG systems shall be in compliance with Information Assurance Vulnerability Alert (IAVA) guidance.

B. IDS Modes of Operation

1. General Information

- a) The system shall operate in either armed or disarmed mode.
- b) There shall be no remote capability for changing the mode of operation by non-SCI cleared personnel.
- c) Changing arm/disarm status of the system shall be limited to SCI-indoctrinated personnel.

2. Requirements for Disarmed Mode

- a) When in disarmed mode, normal authorized entry into the SCIF, in accordance with prescribed security procedures, shall not cause an alarm.
- b) A record shall be maintained that identifies the person responsible for disarming the system.
- c) Tamper circuits and emergency exit door circuits shall remain in the armed mode of operation.
- d) The PCU shall have the ability to allow alarm points to remain in armed status while other points are in disarmed status.

3. Requirements for Armed Mode

- a) The system shall be placed into armed mode when the last person departs the SCIF.
- b) A record shall be maintained identifying the person responsible for arming the system.
- c) Each failure to arm or disarm the system shall be reported to the responsible SCIF Security Manager. Records of these events shall be maintained for two years.
- d) When in the armed mode, any unauthorized entry into the SCIF shall cause an alarm to be immediately transmitted to the monitoring station.

4. Requirements for Maintenance and Zone Shunting/Masking Modes

- a) When maintenance is performed on a system, the monitoring station must be notified and logged. The initiation of system maintenance can only be performed by an SCI cleared IDS administrator or SCIF Security Officer (SO).

- b) When an IDE point is shunted or masked for reasons other than maintenance, it shall be displayed as such at the monitoring station throughout the period the condition exists.
 - c) Any sensor that has been shunted shall be reactivated upon the next change in status from armed to disarmed.
 - d) All maintenance periods shall be archived in the system.
 - e) A Personal Identification Number (PIN) is required, for maintenance purposes, to be established and controlled by the SCI cleared IDS administrator or SCIF SO. Procedures shall be documented in the SCIF SOP.
 - f) Portable Electronic Devices (PEDs) are allowed attachment to system equipment either temporarily or permanently for the purposes of system maintenance, repair and reporting (See A.3.c). In addition, when utilizing a stand-alone device, the requirements below shall be met.
 - (1) Such devices shall be kept under control of SCI-cleared personnel.
 - (2) When not in use, the PED shall be maintained in a Physically Protected Space (see A.3.c.2.a).
 - (3) Mass storage devices containing SCIF alarm equipment details, configurations, or event data will be protected at an appropriate level approved by the AO.
 - g) After the initial installation, the capability for remote diagnostics, maintenance, or programming of IDE shall be accomplished only by SCI-cleared personnel and shall be logged or recorded.
5. Requirements for Electrical Power
- a) In the event of primary power failure, the system shall automatically transfer to an emergency electrical power source without causing alarm activation.
 - b) Twenty-four hours of uninterruptible backup power is required and shall be provided by batteries, an uninterruptible power supply (UPS), generators, or any combination.
 - c) An audible or visual indicator at the PCU shall provide an indication of the primary or backup electrical power source in use.
 - d) Equipment at the monitoring station shall visibly and audibly indicate a failure in a power source or a change in power source. The individual system that failed or changed shall be indicated at the PCU or monitoring station as directed by the AO.
6. Monitoring Stations
- a) Monitoring stations shall be government-managed or one of the following in accordance with UL 2050:
 - (1) AO-operated monitoring station.
 - (2) Government contractor monitoring station (formerly called a proprietary central station).

- (3) National industrial monitoring station.
- (4) Cleared commercial central station (see NISPOM, Chap. 5).
- b) Monitoring station employees shall be eligible to hold a U.S. SECRET clearance.
- c) Monitoring station operators shall be trained in system theory and operation to effectively interpret system incidents and take appropriate response action.
- d) Records shall be maintained shall be maintained in accordance with Chapter 12 section L.

C. Operations and Maintenance of IDS

1. Alarm Response

- a) Alarm activations shall be considered an unauthorized entry until resolved.
- b) The response force shall take appropriate steps to safeguard the SCIF, as permitted by a written support agreement, until an SCI-indoctrinated individual arrives to take control of the situation.
- c) An SCI indoctrinated individual must arrive in accordance with UL 2050 requirements (60 minutes) or the response time approved by the AO, after receipt of the alarm signal to conduct an internal inspection of the SCIF, attempt to determine the probable cause of the alarm activation, and reset the IDS prior to the departure of the response force.

2. System Maintenance

- a) Maintenance and repair personnel shall be escorted if they are not TOP SECRET-cleared and indoctrinated for SCIF access.
- b) Repairs shall be initiated by a service technician within 4 hours of the receipt of a trouble signal or a request for service.
- c) The SCIF shall be continuously manned by SCI-indoctrinated personnel on a 24-hour basis until repairs are completed or alternate documented procedures approved by the AO are initiated.
- d) The following apply to emergency-power battery maintenance:
 - (1) The battery manufacturer's periodic maintenance schedule and procedures shall be followed and documented in the system's maintenance logs and retained for two years. Batteries should be replaced per manufacture's recommendations or as environmental conditions dictate.
 - (2) If the communications path is via a network, the local uninterruptible power source for the network shall also be tested.
 - (3) If a generator is used to provide emergency power, the manufacturers recommended maintenance and testing procedures shall be followed.

e) Network Maintenance

- (1) System administrators shall maintain configuration control, ensure the latest operating system security patches have been applied, and configure the operating system to provide a high level of security.
- (2) Inside the U.S., network maintenance personnel within a SCIF shall be a U.S. person and be escorted by cleared SCIF individuals.
- (3) Outside the U.S., network maintenance personnel shall be U.S. TOP SECRET-cleared or U.S. SECRET-cleared and escorted by SCIF personnel.

D. Installation and Testing of IDS

1. Personnel Requirements

- a) Installation and testing within the U.S. shall be performed by U.S. companies using U.S. citizens.
- b) Installation and testing outside of the U.S. shall be performed by personnel who are U.S. TOP SECRET-cleared or U.S. SECRET-cleared and escorted by SCIF personnel.

2. Installation Requirements

All system components and elements shall be installed in accordance with requirements of this document, UL 2050, and manufacturer's instructions and standards.

3. Testing

- a) Acceptance testing shall be conducted on systems prior to operational use to provide assurance that they meet all requirements of this section prior to SCIF accreditation.
- b) Semi-annual IDS testing shall be conducted to ensure continued performance.
- c) Records of testing and test performance shall be maintained in accordance with documentation requirements.
- d) Motion Detection Sensor Testing
 - (1) All motion detection sensors shall be tested to ensure activation of the sensor at a minimum of four consecutive steps at a rate of one step per second; that is, 30 inches \pm 3 inches or 760 mm \pm 80 mm per second. The four-step movement shall constitute a "trial."
 - (2) The test shall be conducted by taking a four-step trial, stopping for three to five seconds, and taking another four-step trial.
 - (3) Trials shall be repeated throughout the SCIF and from different directions.
 - (4) An alarm shall activate at least three out of every four consecutive trials made by moving progressively through the SCIF.
- e) HSS Testing

All HSS devices shall be tested to ensure that an alarm signal activates before the non-hinged side of the door opens beyond the thickness of the door from the closed position, e.g., the sensor initiates before the door opens 1 $\frac{3}{4}$ inch for a 1 $\frac{3}{4}$ inch door.

f) Tamper Testing

- (1) Each IDS equipment cover shall be individually removed or opened to ensure there is alarm activation at the PCU or monitoring station in both the secure and access modes.
- (2) Tamper detection devices need only be tested when installed.
- (3) The AO may require more frequent testing of tamper circuits.

Chapter 8. Access Control Systems (ACS)

A. SCIF Access Control

1. Guidelines

- a) SCIFs shall be controlled by SCI-indoctrinated personnel or by an AO- approved ACS to ensure access is restricted to authorized personnel.
- b) Personnel access control shall be utilized at all SCIFs.
- c) Visual recognition of persons entering the SCIF by an SCI-indoctrinated person at the entrance to a SCIF is the ideal access control.
- d) Entrances where visitor control is conducted shall be under continuous visual observation unless the SCIF is properly secured.
- e) When the SCIF is an entire building, access control shall occur at the building perimeter.

2. ACS Requirements if Continuous Visual Observation is Not Possible

- a) An automated personnel ACS that verifies an individual's identity before the individual is permitted unescorted access shall be utilized when personal recognition and verification is not used. Automated verification shall employ **two** of the following three technologies:
 - (1) Identification (ID) badge or card used in conjunction with the access control device that validates the identity of the person to whom the card is issued. Compromised or lost access cards shall be reported immediately and updated in the system to reflect "no access."
 - (2) A personal identification number (PIN) that is entered into the keypad by each individual. The PIN shall consist of four or more random digits, with no known or logical association to the individual or which can be derived from the person or system generated. Compromised PINs shall be reported immediately to the facility Security Officer (SO) or SCIF SO and updated in the system to reflect "no access."
 - (3) Biometric personal identity verification using unique personal characteristics such as fingerprint, iris scan, palm print, etc.
- b) The automated personnel ACS shall ensure that the probability of an unauthorized individual gaining access is no more than one in ten thousand while the probability of an authorized individual being rejected access is no more than one in one thousand. Manufacturers must certify in writing that their system meets these criteria.

B. ACS Administration

1. ACS administrators shall be SCI-indoctrinated.
2. Remote release buttons that by-pass the ACS shall be inside the SCIF and in a location that provides continuous visual observation of personnel entering the SCIF.
3. ACSs shall not be used to secure an unoccupied SCIF.
4. When not occupied, SCIFs shall be alarmed and in secure mode in accordance with Chapter 7 and secured with an approved GSA FF-L-2740A combination lock.
5. Authorized personnel who permit another individual to enter the SCIF shall verify the individual's authorized access.
6. SCIF access authorization shall be removed when the individual is transferred, terminated, or the access approval is suspended or revoked.

C. ACS Physical Protection

1. Card readers, keypads, communication interface devices, and other access control equipment located outside the SCIF shall be tamper-protected and be securely fastened to a wall or other fixed structure.
2. Electrical components, associated wiring, or mechanical links shall be accessible only from inside the SCIF.
3. System data that is carried on transmission lines (e.g., access authorizations, personal identification, or verification data) to and from equipment located outside the SCIF shall be protected using FIPS AES certified encrypted lines. If this communication technology is not feasible, transmission lines shall be installed as approved by the AO.
4. Equipment containing access-control software programs shall be located in the SCIF or a SECRET controlled area.
5. Electric door strikes installed in conjunction with a personnel ACS shall have a positive engagement and be approved under UL 1034 for burglar resistance.

D. ACS Recordkeeping

1. Records shall reflect the active assignment of ID badge/card, PIN, level of access, entries, and similar system-related information.
2. Records and information concerning encoded ID data, PINs, Authentication data, operating system software, or any other data associated with the personnel ACS shall be secured in an open-storage facility or, when unattended, secured in a GSA-approved container in a closed-storage facility. Access to such data shall be restricted to only SCI-indoctrinated personnel responsible for the access control system.
3. Records of personnel removed from the system shall be retained for two years from the date of removal.

4. Records of security incidents (violations/infractions) regarding ACS shall be retained by the SO for five years from the date of an incident or until investigations of system violations and incidents have been resolved.

E. Using Closed Circuit Television (CCTV) to Supplement ACS

1. CCTV may be used to supplement the monitoring of a SCIF entrance for remote control of the door from within the SCIF. The system shall present no technical security hazard.
2. The remote control device shall be within the interior of the SCIF.
3. The system shall provide a clear view of the SCIF entrance and shall be monitored/operated by SCI-indoctrinated personnel within the SCIF.
4. CCTV communication lines should be located within the SCIF. Communication lines that must run external to the SCIF shall be installed to prevent tampering as approved by the AO.

F. Non-Automated Access Control

1. Non-automated access control devices (mechanical, electric, or electromechanical) may be approved by the AO to control access to SCIFs where the number of personnel that require access is low and there is only one entrance.
2. Combinations shall consist of four (4) or more random digits.
3. The use of pass keys to bypass such devices should be avoided except when local fire/safety codes require them. Any pass keys for such devices must be strictly controlled by SCI-indoctrinated personnel.
4. Mechanical access control devices (e.g., UNICAN, Simplex) shall be installed to prevent manipulation or access to coding mechanisms from outside the door.
5. The following shall apply to electric or electromechanical access control devices:
 - a) The control panel or keypad shall be installed in such a manner to preclude unauthorized observation of the combination or the actions of a combination change.
 - b) The selection and setting of combinations shall be accomplished by the SO and shall be changed when compromised or deemed necessary by the SO.
 - c) The control panel in which the combination and all associated cabling and wiring is set shall be located inside the SCIF and shall have sufficient physical security to deny unauthorized access to its mechanism.

This page intentionally left blank.

Chapter 9. Acoustic Protection

A. Overview

1. This establishes DNI guidelines to protect classified conversations from being inadvertently overheard outside a SCIF.
2. This is not intended to protect against deliberate technical interception of audio emanations.

B. Sound Group Ratings

The ability of a SCIF structure to retain sound within the perimeter is rated using a descriptive value, the Sound Transmission Class (STC). To satisfy the normal security standards of SCIFs, the following transmission attenuation groups have been established:

- Sound Group 3 - STC 45 or better. Loud speech from within the SCIF can be faintly heard but not understood outside of the SCIF. Normal speech is unintelligible with the unaided human ear.
- Sound Group 4 - STC 50 or better. Very loud sounds within the SCIF, such as loud singing, brass music, or a radio at full volume, can be heard with the human ear faintly or not at all outside of the SCIF.

C. Acoustic Testing

1. Audio tests shall be conducted to verify standards are met. Tests may be instrumental or non-instrumental as approved by the AO. Test method used shall be detailed in the CSP.
2. Instrumental Acoustic Tests
 - a) Only those with training on audio testing techniques shall conduct instrumental acoustic tests
 - b) With all SCIF doors closed, all perimeter walls and openings (e.g., air returns, doors, windows, etc.) shall be tested along multiple points to ensure that either Sound Group 3 or 4 is met.
 - c) Audio test sources shall have a variable sound level output.
 - d) The output frequency range shall include normal speech.
 - e) Test speakers shall be placed six feet from the test wall and 4 feet off the floor.
 - f) Audio gain of the test source shall produce “loud or very loud speech” as defined by Sound Group 3 and 4 levels respectively.

- g) As an alternative, instrumented testing may be performed to Noise Isolation Class (NIC) standards. Results shall comply with NIC 40 for Sound Group 3 and NIC 45 for Sound Group 4.
- 3. Non-Instrumental Acoustic Tests
 - All non-instrumental tests shall be approved by the AO.

D. Construction Guidance for Acoustic Protection

- 1. The SCIF perimeter shall be designed and constructed to meet Sound Group 3 or better standards. (See construction drawings for Wall A, B, or C.)
- 2. Areas that provide for amplified conversations, such as conference centers, video teleconference (VTC) rooms, or similar areas, shall be designed and constructed to meet Sound Group 4 standards. (See construction drawings for Wall A, B, or C.)
- 3. Utility (e.g., power, signal, telephone) distribution shall be surface mounted to a sound-treated wall and shall not completely penetrate the sound-engineered structure.

E. Sound Transmission Mitigations

- 1. Construction of walls as described in Chapter 3 (Wall types A, B and C) or with brick, concrete, or other substantive material and acoustically treating penetrations, walls and doors should provide the necessary acoustic protection for Sound group 3.
- 2. When Sound Group 3 or 4 cannot be met with normal construction, supplemental mitigations to protect classified discussions from being overheard by unauthorized persons may include but not be limited to the following:
 - a) Structural enhancements such as the use of high-density building materials (i.e., sound deadening materials) can be used to increase the resistance of the perimeter to vibration at audio frequencies.
 - b) Facility design can include a perimeter location or stand-off distance which prevents non-SCI-indoctrinated person(s) traversing beyond the point where SCI discussions become susceptible to interception. For example, use of a perimeter fence or protective zone between the SCIF perimeter walls and the closest "listening place" is permitted as an alternative to other sound protection measures.
 - c) Sound masking devices, in conjunction with an amplifier and speakers or transducers, can be used to generate and distribute vibrations or noise; noise sources may be noise generators, tapes, discs, or digital audio players.
 - d) Speakers/transducers must produce sound at a higher level than the voice conversations within the SCIF.
 - e) Speakers/transducers shall be placed close to, or mounted on, any paths that would allow audio to leave the area, including doors, windows, common perimeter walls, vents/ducts, and any other means by which voice can leave the SCIF.

- f) Wires and transducers shall, to the greatest extent possible, be located within the perimeter of the SCIF.
- g) The sound masking system shall be subject to inspection during TSCM evaluations.
- h) If the AO determines risk to be low, a speaker may be installed outside the SCIF door if the following conditions are met:
- The cable exiting the SCIF shall be encased within rigid conduit.
 - The sound masking system shall be subject to review during TSCM evaluations.
- i) For common walls, the speakers/transducers shall be placed so the sound optimizes the acoustical protection.
- j) For doors and windows, the speakers/transducers shall be placed close to the aperture of the window or door and the sound projected in a direction facing away from conversations.
- k) Once the speakers or transducers are optimally placed, the system volume shall be set and fixed. The volume level for each speaker shall be determined by listening to conversations outside the SCIF or area to be protected, and the speaker volume adjusted until conversations are unintelligible from outside the SCIF.
- l) Sound-source generators shall be permanently installed and not contain an AM/FM receiver and shall be located within the SCIF.
- m) Any sound-source generator within the SCIF that is equipped with a capability to record ambient sound shall have that capability disabled.
- n) Examples of government-owned or government-sponsored sound-source generators are given below:
- Audio amplifier with a standalone computer (no network connection).
 - Audio amplifier with a cassette tape player, compact disc (CD) player, or digital audio player, or with a digital audio tape (DAT) playback unit.
 - Integrated amplifier and playback unit incorporating any of the above music sources.
 - A noise generator or shift noise source generator using either white or pink noise.

This page intentionally left blank.

Chapter 10. Portable Electronic Devices with Recording Capabilities and Embedded Technologies (PEDs/RCET)

A. Approved Use of PEDs/RCET in a SCIF

1. DNI Executive Correspondence, ES 2017-00043, Wireless Technology in the Intelligence Community, should be referred to in all cases dealing with Portable Electronic Devices with Wireless capabilities.
2. Heads of IC elements will institute and maintain mitigation programs (countermeasures) if they allow introduction of PEDs/RCETs with recording capabilities into SCIFs under their cognizance. Such decisions are not reciprocal or applicable to facilities under the cognizance of other heads of IC elements.
3. Medical devices. Approval for medical devices will comply with all applicable laws and oversight policies, including the Rehabilitation Act, and the latest IC medical device approval process. As a minimum, the medical device must be reviewed to determine any technical security issues introduced by the device. Based on the security/technical review, medical devices may be approved by the AO for introduction and use within a SCIF.
4. Recording capabilities and restricted technologies are technologies that introduce vulnerabilities to information and therefore impact SCIF security. These technologies include, but are not limited to, radio frequency transmitters, audio and video recorders, cameras, microphones, data storage devices, computing devices, memory sticks, thumb drives or flash memory and devices with USB connectivity.
5. Any approval for radio frequency transmitters shall require the AO and the Certified TEMPEST Technical Authority (CTTA) collaborate and approve (as required) the introduction and use of PEDs/RCETs into a SCIF where there is a valid mission related requirement.
6. The AO, and when appropriate, the information systems (ISs) authorizing official(s), shall collaborate and approve (as required) the introduction and use of PEDs/RCETs into a SCIF when there is a valid mission related requirement.
7. Outside the U.S., heads of intelligence elements may approve PED/RCET usage by waiver and include the following:
 - Defined mission need for PED/RCET usage.
 - Defined period of time.
 - Statement of residual risk
8. Within the U.S., if the AO determines the risk from PEDs/RCET to SCI under their cognizance is acceptable, taking a PED/RCET into the SCIF may be allowed with the following restrictions:
 - a) A comprehensive risk assessment addressing each vulnerability, security concern and the component of risk must be completed.

- b) Only PEDs/RCET with low risk may be allowed entry to a SCIF.
- c) Mitigation shall be applied to PEDs/RCET evaluated to be high and medium risk to reduce the PED/RCET risk to low before the device may be allowed entry.
- d) Assessments may result in an AO determination to prohibit specific PEDs/RCET.

B. Prohibitions

1. Personally-owned PEDs/RCETs are prohibited from processing SCI. Connecting personally-owned PEDs/RCETs to an unclassified IS inside SCIFs may only be done when wireless capability is physically disconnected and has the approval of the AO for the IS.
2. Personally-owned PEDs/RCETs are prohibited in SCIFs outside the U.S. If the AO determines that mission requirements dictate a need, government- or contractor-owned PEDs/RCETs may be permitted in a SCIF by specific exception or if the AO determines the risk is low.
3. If a PED/RCET is transported outside the U.S. and left unattended or physical control is lost, that device shall not be reintroduced into a SCIF.

C. PED/RCET Risk Levels

1. General Information
 - a) Levels of risk are based on the functionality of PEDs/RCET.
 - b) The AO and appropriate authorizing official for the IS (when a portable IS is involved) will determine risk level and mitigation requirements for devices not addressed.
2. Low-, Medium-, and High-risk PEDs/RCET.
 - a) Low-risk PEDs/RCET are devices without recording or transmission capabilities and may be allowed into a SCIF by AO without mitigation. Low-risk PEDs/RCET include, but are not limited to, the following:
 - Electronic calculators, spell checkers, language translators, etc.
 - Receive-only pagers.
 - Audio and video playback devices with no storage capability.
 - Radios (receive-only).
 - Infrared (IR) devices that convey no intelligence data (e.g., text, audio, video, etc.), such as an IR mouse or remote control.
 - b) Medium-risk PEDs/RCET are devices with built-in features that enable recording or transmitting digital text, digital images/video, or audio data; however, these features can be physically disabled. Medium-risk PEDs/RCET may be allowed in a

SCIF by the AO with appropriate mitigations. Examples of medium-risk PEDs/RCET include, but are not limited to, the following:

- Voice-only cellular telephones.
- Portable ISs, such as personal digital assistants (PDAs), tablet personal computers, etc.
- Devices that may contain or be connected to communications modems
- Devices that have microphones or recording capabilities

c) High-risk PEDs/RCET are those devices with recording and/or transmitting capabilities that require more extensive or technically complex mitigation measures to reduce the inherent risk or those that cannot be sufficiently mitigated with current technology. The AO may approve entry and use of government- and contractor-owned PEDs/RCET for official business provided mitigation measures are in place that reduces the risk to low. Examples include, but are not limited to, the following:

- Electronic devices with RF transmitting (IEEE 802.11, Bluetooth, etc.).
- Photographic, video, and audio recording devices.
- Multi-function cellular telephones.

D. Risk Mitigation

1. Heads of IC elements shall establish risk mitigation programs if high- or medium-risk PEDs/RCET are allowed into SCIFs.
2. Risk mitigation programs shall contain the following elements:
 - a) Formal approval process for PEDs/RCET.
 - b) Initial and annual refresher training for those individuals with approval to bring PEDs/RCET into a SCIF.
 - c) Device mitigation compliance documents listing the specific PEDs/RCET, their permitted use, required mitigations, and residual risk after mitigation.
 - d) A user agreement that specifies the following:
 - (1) The USG or a designated representative may seize the PED/RCET for physical and forensic examination at the government's discretion.
 - (2) The USG and the designated representative are not responsible for any damage or loss to a device or information stored on personally-owned PEDs/RCET resulting from physical or forensic examination.
3. Risk mitigation programs may include the following elements:
 - a) Registration of PED/RCET serial numbers.
 - b) PED/RCET security training program.
 - c) Reporting procedures for loss or suspected tampering.

- d) Labeling approved PEDs/RCET for easy identification.
- e) Electronic detection equipment to detect transmitters/cell phones.

Chapter 11. Telecommunications Systems

A. Applicability

1. This guidance is compatible with, but may not satisfy, security requirements of other disciplines such as Information Systems Security, Communications Security (COMSEC), Operational Security (OPSEC), or TEMPEST.
2. This section outlines the security requirements that shall be met to ensure the following:
 - Protection of information.
 - Configuration of unclassified telecommunications systems, devices, features, and software.
 - Access control.
 - Control of the cable infrastructure.

B. Unclassified Telephone Systems

1. A baseline configuration of all unclassified telephone systems, devices, features, and software shall be established, documented, and included in the SCIF FFC.
2. The AO shall review the telephone system baseline configuration and supporting information to determine if the risk of information loss or exploitation has been suitably mitigated.
3. When security requirements cannot be met, unclassified telephone equipment shall be installed and maintained in non-discussion areas only.
4. When not in use, unclassified telephone systems shall not transmit audio and shall be configured to prevent external control or activation, technical exploitation, or penetration.
5. Unclassified telephone systems shall incorporate physical and software access controls to prevent disclosure or manipulation of system programming and data. The following specific requirements shall be met:
 - a) On-hook and off-hook audio protection shall be provided by equipment identified by the National Telephone Security Working Group within TSG-6/CNSSI 5006, National Instruction for Approved Telephone Equipment, or an equivalent TSG 2/CNSSI 5002:
 - (1) The purpose of a TSG-2 or CNSS 5002 Computerized Telephone Switch (CTS) installation is to prevent manipulation of telephone instruments to obtain audio from within the SCIF while the instrument is in an "on-hook" condition.
 - (2) When isolation is provided by a CTS installed IAW TSG-2 or CNSS 5002, the AO accepts the risk on-hook audio from the SCIF may be present on all instrument wiring until it reaches the CTS due to instrument configuration, design, or breakdown. *(TSG-2/CNSS 5002 does not address procedures to determine security of the station itself.)*

- (3) To provide the necessary level of security, the Physically Protected Space (PPS) where the CTS is installed must meet equivalent security and access control standards as the SCIF it supports to provide positive physical protection for the CTS and all of its parts. (CNSSI 5002 para 7.A.(1)). This includes all instruments, cables, lines, intermediate wiring frames, and distributed CTS modules necessary for the functioning of the instruments.
- (4) The AO may require all instrument wiring exiting between the SCIF and PPS which is not at the SCIF level be contained in a closed and sealed metal conveyance as defined in Chapter 7.A.2 to ensure physical security of the instrument wiring.
- (5) Telephones or instruments not type-accepted will be presumed to have on-hook audio available at the mounting cord until determined otherwise. Determining telephone stations do not have on-hook audio hazards requires a technical investigation and specific equipment. These investigations and determinations may only be conducted by a TSCM team or National Telephone Security Working Group (NTSWG) authorized telephone laboratory.
- b) If a Computerized Telephone System (CTS) is selected for isolation, it shall be installed and configured as detailed in TSG 2 with software and hardware configuration control and audit reporting (such as station message detail reporting, call detail reporting, etc.).
- c) System programming shall not include the ability to place, or keep, a handset off-hook.
- d) Configuration of the system shall ensure that all on-hook and off-hook vulnerabilities are mitigated.
- e) When local or remote CTS administration terminals are not contained within a controlled area and safeguarded against unauthorized manipulation, the use of CNSSI 5006 approved telephone instruments shall be required, regardless of the CTS configuration.
- f) Speakerphones and audio conferencing systems shall not be used on unclassified telephone systems in SCIFs. Exceptions to this requirement may be approved by the AO when these systems have sufficient audio isolation from other classified discussion areas in the SCIF and procedures are established to prevent inadvertent transmission outside the SCIF.
- g) Features used for voice mail or unified messaging services shall be configured to prevent access to remote diagnostic ports, internal dial tone, and dial plans.
- h) Telephone answering devices and facsimile machines shall not contain features that introduce security vulnerabilities, e.g., remote room monitoring, remote programming, or other similar features that may permit off-premise access to room audio.
- i) All unclassified telephone systems and associated infrastructure shall be physically isolated from classified information and telecommunications systems in accordance with DNI and CNSS TEMPEST guidance.

j) TSG6/CNSSI 5006 approved instruments or compliance with CNSSI 5000 is required for installation in SCIFs for Voice over Internet Protocol (VoIP) systems installed in a SCIF. TSG6/CNSSI 5006 approved instruments must be installed following the manufacturer's requirements. For non-TSG6/CNSSI 5006 approved instruments, the security requirements and installation guidelines contained in the National Telecommunications Security Working Group (NTSWG) publication CNSSI 5000 shall be followed for Voice over Internet Protocol (VoIP) systems installed in a SCIF.

C. Unclassified Information Systems

1. Unclassified information systems shall be safeguarded to prevent hardware or software manipulation that could result in the compromise of data.
2. Information systems equipment with telephonic or audio features shall be protected against remote activation and/or removal of audio (analog or digitized) information.
3. Video cameras used for unclassified video teleconferencing and video recording equipment shall be deactivated and disconnected when not in use.
4. Video devices shall feature a clearly visible indicator to alert SCIF personnel when recording or transmitting.

D. Using Closed Circuit Television (CCTV) to Monitor the SCIF Entry Point(s)

1. CCTV may be used to supplement the monitoring of a SCIF entrance and to record events for investigation.
2. The system shall present no technical security hazard to the SCIF.
3. The system and all components, including communications and control lines, shall be exterior to the SCIF perimeter.
4. The system may provide a clear view of the SCIF entrance but not enable the viewer to observe classified information when the door is open nor external control pads or access control components that would enable them to identify PINs.

E. Unclassified Wireless Network Technology

1. The use of devices or systems utilizing wireless technologies pose a high risk and require approval from the AO, CTTA, and IT systems approving authority prior to introduction into the SCIF.
2. Wireless systems shall meet all TEMPEST and TSCM requirements and shall be weighed against the facilities overall security posture (i.e., facility location, threat, as well as any compensatory countermeasures that create SID) when evaluating these systems.

3. All separation and isolation standards provided in TEMPEST standards are applicable to unclassified wireless systems installed or used in SCIFs.

F. Environmental Infrastructure Systems

1. The FFC shall include information on whether or not environmental infrastructure systems (also referred to as building maintenance systems) are located in the SCIF.

Examples include the following:

- Premise management systems
- Environmental control systems
- Lighting and power control units
- Uninterrupted power sources

2. The FFC shall identify all external connections for infrastructure systems that service the SCIF. Examples of the purpose of external connections include the following:

- Remote monitoring
- Access and external control of features and services
- Protection measures taken to prevent malicious activity, intrusion, and exploitation.

G. Emergency Notification Systems

1. The introduction of electronic systems that have components outside the SCIF perimeter is prohibited, with the following exceptions:

- a) The system is approved by the AO.
- b) The system is required for security purposes.
- c) The system is required under life safety regulations.

2. If required, and speakers or other transducers are part of a system that is not wholly contained in the SCIF but are installed in the SCIF for life safety or fire regulations, the system must be protected as follows:

- a) All incoming wiring shall breach the SCIF perimeter at one point. TEMPEST or TSCM concerns may require electronic isolation and shall require review and approval by the CTTA.
- b) One-way (audio into the SCIF) communication systems shall have a high gain amplifier.
- c) Two-way communication systems shall only be approved when absolutely necessary to meet safety/security requirements. They shall be protected so that audio cannot leave the SCIF without the SCIF occupants being alerted when the system is activated.

- d) All electronic isolation components shall be installed within the SCIF and as close to the point of SCIF penetration as possible.

H. Systems Access

1. Installation and maintenance of unclassified systems and devices supporting SCIF operations may require physical or remote access. The requirements outlined in this section shall apply to telecommunications devices located within the SCIF or in a controlled area outside the SCIF.
2. Installation and maintenance personnel requiring physical access shall possess the appropriate clearance and access, or will be escorted and monitored at all times within the SCIF by technically knowledgeable, U.S. SCI-indoctrinated personnel.
3. Remote maintenance shall be protected against manipulation or activation.
4. All capabilities for remote maintenance and diagnostic services shall be specified in the FFC.
5. The FFC shall identify all procedures and countermeasures to prevent unauthorized system access, unauthorized system modification, or introduction of unauthorized software.
6. Remote maintenance and diagnosis may be performed from a SCIF or an adjacent controlled area over a protected link in accordance with FIPS AES standards.
7. Telephone systems only may be accessed over an unclassified telephone line as specified in TSG 2 Standard, Section 4.c.

I. Unclassified Cable Control

1. To the extent possible, all telecommunications cabling shall enter the SCIF through a single opening and allow for visual inspection.
2. Cable, either fiber or metallic, shall be accounted for from the point of entry into the SCIF.
 - a) The accountability shall identify the precise use of every cable through labeling.
 - b) Log entries may also be used.
 - c) Designated spare conductors shall be identified, labeled, and bundled together.
3. Unused conductors shall be removed. If removal is not feasible, the metallic conductors shall be stripped, bound together, and grounded at the point of ingress/egress.
4. Unused fiber shall be uncoupled from the interface within the SCIF, capped, and labeled as unused fiber.

J. Protected Distribution Systems

1. Unencrypted communication cables transmitting SCI between accredited SCIFs shall be installed in a Protective Distribution System that complies with standards established in CNSSI 7003, Protected Distribution System.
2. PDS used to protect SCI shall be approved by the CSA AO.

K. References

1. Overview
 - a) The NTSWG publishes guidance for the protection of sensitive information and unclassified telecommunications information processing systems and equipment.
 - b) NTSWG documents are currently in transition from TSG/NTSWG documents to Committee on National Security Systems (CNSS) publications.
 - c) The List of References is provided for use by personnel concerned with telecommunications security.
2. List of References
 - a) TSG Standard 1 (Introduction to Telephone Security). Provides telephone security background and approved options for telephone installations in USG sensitive discussion areas.
 - b) TSG Standard 2 (TSG Guidelines for Computerized Telephone Systems) and Annexes. Establishes requirements for planning, installing, maintaining, and managing CTS, and provides guidance for personnel involved in writing contracts, inspecting, and providing system administration of CTS.
 - c) TSG Standards 3, 4, 5, and CNSSI 5001. Contains design specifications for telecommunication manufacturers and are not necessarily applicable to facility security personnel.
 - d) CNSSI 5000. Establishes requirements for planning, installing, maintaining, and managing VoIP systems.
 - e) CNSSI 5006. Lists approved equipment which inherently provide on-hook security.
 - f) NTSWG Information Series (Computerized Telephone Systems). A Review of Deficiencies, Threats, and Risks, December 1994). Describes deficiencies, threats, and risks associated with using computerized telephone systems.
 - g) NTSWG Information Series (Executive Overview, October 1996). Provides the salient points of the TSG standards and presents them in a non-technical format.
 - h) NTSWG Information Series (Central Office (CO) Interfaces, November 1997). Provides an understanding of the types of services delivered by the local central office and describes how they are connected to administrative telecommunications systems and devices.

- i) NTSWG/NRO Information Series (Everything You Always Wanted to Know about Telephone Security...but were afraid to ask, 2nd Edition, December 1998). Distills the essence of the TSG standards (which contain sound telecommunications practices) and presents them in a readable, non-technical manner.
- j) NTSWG/NRO Information Series (Infrastructure Surety Program...securing the last mile, April 1999). Provides an understanding of office automation and infrastructure system protection that contributes to SCIF operation.
- k) NTSWG Information Series (Computerized Telephone Systems Security Plan Manual, May 1999). Assists to implement and maintain the “secure” operation of CTSs as used to support SCIF operations. (The term “secure” relates to the safe and risk-free operation, not the use of encryption or a transmission security device.)
- l) Director of National Intelligence, Intelligence Community Directive 702, Technical Surveillance Countermeasures.
- m) Director of National Intelligence, Intelligence Community Directive 503, Intelligence Community Information Technology Systems Security Risk Management, Certification and Accreditation.
- n) SPB Issuance 00-2 (18 January 2000). Infrastructure Surety Program and the Management Assessment Tool.

This page intentionally left blank.

Chapter 12. Management and Operations

A. Purpose

To establish safeguards and procedures necessary to prevent the unauthorized disclosure of SCI and other classified national security information in SCIFs. To define administrative processes that shall provide a secure operating environment and enable adequate security oversight, management, and operations of SCIFs.

B. SCIF Repository

1. As required by ICD 705, the DNI shall manage an inventory of information on all SCIFs which shall be reported to the DNI via the SCIF repository not later than 180 days after the effective date of ICD 705 and updated no later than 30 days after changes occur thereafter.

2. Reportable SCIF Administrative Information:

- SCIF ID
- AO ID
- Location of SCIF
 - In U.S.
 - Outside U.S.
 - Under COM
- SCIF Type
 - Closed Storage
 - Open Storage
 - SWA
 - TSWA
 - T-SCIF
- SID
- Initial Accredited Date
- Re-Accreditation Date
- Review date
- Waivers
- Date waiver approved
- Waiver approval authority/ID
- Exceeded standards
- Does not meet standards
- Date waiver expires

C. SCIF Management

1. SO Responsibilities:

- a) The SCIF SO shall be responsible for all aspects of SCIF management and operations to include security policy implementation and oversight.
- b) The SO shall prepare a comprehensive Standard Operating Procedure (SOP) that documents management and operations of the SCIF.
- c) The SO shall review the SOP at least annually and revise it when any aspect of SCIF security changes.
- d) The SO shall issue and control all SCIF keys. Locks shall be changed when a key is lost or is believed to be compromised.
- e) The SO shall conduct annual self-inspections to ensure the continued security of SCIF operations, identify deficiencies, and document corrective actions taken. Inspection results shall be forwarded to the AO and copies retained by the SO until the next inspection.
- f) The SO shall create an emergency plan to be approved by the AO. Plans shall be reviewed and updated annually and all SCIF occupants shall be familiar with the plans. Drills shall be conducted as circumstances warrant, but at least annually. The emergency plan may be an extension of an overall department, agency, or installation plan.

(1) For SCIFs within the U.S., emergency plans shall address the following:

- Fire
- Natural disaster
- Civil unrest
- Intrusion detection system failures
- Admittance of emergency personnel
- The protection of SCIF occupants and classified information
- Evacuation requirements and emergency destruction

(2) For SCIFs outside the U.S., emergency plans shall address all of the above and shall include instructions for the emergency destruction or removal of SCI where political instability, terrorism, host country attitudes, or criminal activity suggest the possibility that a SCIF may be overrun.

- g) The SO shall control passwords to access the maintenance mode of copiers and other office equipment.
- h) The SO shall develop an SOP that addresses actions to be taken when IDS maintenance access is required.

2. Required SCIF Documentation

- a) Copies of all documents relating to SCIF accreditation shall be maintained by the SCIF SO and include, but not limited to, the following:

- SCIF accreditation
 - Fixed facility checklist
 - Construction security plan
 - CTTA evaluation
 - IS accreditation
 - SOPs
 - The results of the final acceptance test of the original system installation and any tests to system modifications made thereafter
 - Emergency plan
- b) As applicable, the following documents shall be maintained by the SCIF SO:
- TSCM reports
 - Co-utilization agreements
 - Memoranda of agreement
 - Self-inspection reports
 - Compartmented area checklist
 - Shipboard SCIF checklist
 - Aircraft/UAV checklist
 - A copy of the CRZH certificate (UL 2050)
 - Pre-Construction Checklist Form

D. SOPs

1. A comprehensive SOP that documents management and operations of the SCIF shall be prepared by the SO.
2. The SOP shall be included in the accreditation package and approved by the AO.
3. All individuals assigned to, or having unescorted access to, the SCIF shall be familiar with and adhere to the SOP.
4. All SOP revisions shall be provided to the AO for approval.
5. SOPs shall be tailored to a specific SCIF.
6. SOPs shall include specific areas of security concern as defined by program or mission requirements.
7. The following are examples of subjects that should be addressed in an SOP:
 - Self-inspections
 - Security incidents and violations
 - Alarm systems and response requirements
 - Opening and closing procedures
 - Access controls
 - Visitor access
 - Escort procedures
 - Equipment maintenance procedures

- Handling, processing, and destruction of classified material
- Badge procedures
- End-of-day security procedures
- Personnel and package inspection procedures
- Secure communications device instructions

E. Changes in Security and Accreditation

1. Changes affecting the security posture of the SCIF shall be immediately reported by the SO to the AO to include any corrective or mitigating actions taken.
2. If an AO determines that SCIF security conditions are unsatisfactory, SCIF accreditation may be suspended or revoked.
 - a) All appropriate authorities and SCIF occupants shall be immediately notified and the SCIF closed until deficient conditions are corrected.
 - b) All SCI material shall be relocated to another SCIF.

F. General

1. Except for law enforcement officials or other personnel required to be armed in the performance of their duties, firearms and other weapons are prohibited in SCIFs.
2. Photography, video, and audio recording equipment are restricted but may be authorized for official purposes as documented in the SOP.
3. Procedures shall be established to control IT storage media upon entering or exiting a SCIF in accordance with ICD 503 (Intelligence Community Information Technology Systems Security Risk Management, Certification and Accreditation).
4. SCIF perimeter doors shall remain closed and controlled at all times. When a door needs to be open, it shall be continually monitored by an SCI-indoctrinated individual.
5. All SCIF occupants shall be familiar with emergency plans and drills shall be conducted as circumstances warrant, but at least annually.
6. Where the risk of hostile action is significant, SCI materials shall be maintained at an absolute minimum.

G. Inspections/Reviews

1. SCIF inspections shall be performed by the AO, or designee, prior to accreditation.
2. The AO, or designee, shall conduct periodic security inspections/reviews to ensure the efficiency of SCIF operations, identify deficiencies, and document corrective actions taken. All relevant documentation associated with SCIF accreditation, inspections, and security administration may be subject to review.
3. Periodic inspections/reviews shall be conducted based on threat, facility modifications, sensitivity of programs, past security performance, or at least every five years.
4. SOs shall conduct annual self-inspections to ensure the continued security of SCIF operations, identification of deficiencies, and to document corrective actions taken. Inspection results shall be forwarded to the AO and copies retained by the SO until the next inspection.
5. Authorized inspectors shall be admitted to a SCIF without delay or hindrance when inspection personnel are properly certified to have the appropriate level of security clearance and SCI indoctrination for the security level of the SCIF.
6. Short-notice or emergency conditions may warrant entry without regard to the normal SCIF duty hours.
7. Government-owned equipment needed to conduct SCIF inspections will be admitted into the SCIF without delay. Specifically, equipment for TEMPEST or Technical Surveillance Countermeasures (TSCM) testing shall be admitted to a SCIF as long as the personnel operating the equipment are certified to have the appropriate level of security clearance and SCI indoctrination.
8. Technical Surveillance Countermeasures (TSCM) activities in SCIFs will only be conducted by USG TSCM teams established or sponsored by a USG element. USG TSCM teams consist of USG military or civilian personnel or USG contractors who have successfully completed approved TSCM training.

H. Control of Combinations

1. Combinations to locks installed on security containers/safes, perimeter doors, windows, and any other opening should be changed in the following circumstances:
 - a) When a combination lock is first installed or used.
 - b) When a combination has been subjected, or believed to have been subjected, to compromise.
 - c) Whenever a person knowing the combination no longer requires access to it unless other sufficient controls exist to prevent access to the lock.
 - d) At other times when considered necessary by the SO.

2. When the lock is taken out of service, it will be reset to 50-25-50.
 3. All combinations to the SCIF entrance doors should be stored in a different SCIF.
- When this is not feasible, alternative arrangements shall be made in coordination with the AO.

I. De-Accreditation Guidelines

SCIF closeouts and de-accreditations shall comply with the following procedures:

1. Inspect all areas, storage containers, and furniture for the presence of classified, sensitive, or proprietary information, and remove any found.
2. Reset safe combinations to 50-25-50 and lock the containers.
3. Affix written certification to all storage containers that the container does not contain classified, sensitive, or proprietary information. The certification shall include the date of inspection and the name and signature of the inspector.
4. Ensure that reproduction and printing equipment is decertified or disposed of in accordance with AO guidance.
5. Dispose of, or relocate, SCI computer equipment, media, hard drives, and portable storage media as approved by the AO.
6. Request revocation of Automated Information Systems (AIS) accreditation.
7. Request revocation of SCIF accreditation.
8. If the SCIF will be used for another mission or project that requires alarms, transfer alarm service to the new activity.
9. If the SCIF will not be used for another mission or project and all classified, sensitive, or proprietary information has been removed, the following shall occur:
 - a) Alarm service shall be discontinued.
 - b) Combinations on the entrance door and any GSA containers shall be changed to 50-25-50.
 - c) All keys shall be accounted for.

J. Visitor Access

1. General Requirements
 - a) Visitor logs shall be used to record all SCIF visitors and include the following information:
 - Visitor's full name
 - Organization
 - Citizenship
 - Purpose of the visit

- Point of contact
 - Date/time of the visit
- b) Government-issued identification shall be required as a means of positive identification.
 - c) Visitor logs shall be retained for two years after the date of the last entry.
 - d) Visitor clearance verification shall be accomplished using the DNI Scattered Castles database to the greatest extent possible.
 - e) Visitors whose clearances have not been verified may be permitted, under escort, entry into the SCIF; however, access to and/or discussion of classified information shall be denied pending clearance verification.
 - f) Visitors, SCIF occupants, and their possessions may be subject to screening and inspections to deter the unauthorized removal of classified material or the introduction of prohibited items or contraband.
 - g) Screening and inspection procedures shall be documented and approved by the AO.
2. SCIF Access by Uncleared and Emergency Personnel
 - a) Uncleared personnel shall be escorted at all times by cleared personnel.
 - b) The ratio of cleared escorts to uncleared personnel shall be determined on a case-by-case basis by the SO.
 - c) Prior to assuming escort duties, all escorts shall receive a briefing by the SO or designee outlining their responsibilities.
 - d) Uncleared personnel shall be kept under observation at all times while in the SCIF. Escorts shall ensure precautions are taken to preclude inadvertent access to classified information.
 - e) Lights, signs, or other alerting mechanisms or procedures shall be used to alert SCIF occupants of the presence of uncleared personnel.
 - f) Emergency personnel and equipment shall be allowed access to SCIFs and be escorted to the degree practical. If exposed to classified information, they shall sign an inadvertent disclosure statement when feasible.

K. Maintenance

1. SCI-indoctrinated maintenance personnel shall be used to the extent possible.
2. Procedures for performing maintenance on office equipment, including the use of diagnostic equipment, shall be documented in the SCIF SOP.
3. Computerized diagnostic equipment, to include associated hardware and software, shall be kept under control within a SCIF and shall be managed to prohibit the migration of classified data when connected to classified systems. Procedures shall be documented in the SOP.
4. Passwords to access the maintenance mode of copiers and other office equipment shall be controlled by the SO.
5. Office equipment that is no longer serviceable, such as copiers and classified fax machines, shall be sanitized by having volatile memory erased and non-volatile memory and disk storage removed for terminal destruction.

L. IDS and ACS Documentation Requirements

The following documents and records shall be maintained by the SCIF SO:

1. System Plans such as system design, equipment, and installation documentation.
2. If applicable, agreements established for external monitoring, response, or both, and which shall include the following information:
 - Response time for response forces and SCI indoctrinated personnel.
 - Responsibilities of the response force upon arrival.
 - Maintenance of SCIF points of contact.
 - Length of time response personnel are required to remain on-site.
3. Monitoring Station SOP and/or a copy of the monitoring station UL certificate.
4. Maintenance access SOP.
5. Records, logs, and archives.
6. Records of system testing (for two years) shall include the following information:
 - Testing dates
 - Names of individuals performing the test
 - Specific equipment tested
 - Malfunctions detected
 - Corrective actions taken

7. Records of guard or response force personnel testing as required by the AO.
8. The PCU shall contain a secured, non-volatile event (alarm) log capable of storing at least six months of events, or a printer shall be installed that provides real-time recording of openings, closings, alarms, trouble alarms, and loss of communications.
 - a) If the system has no provision for automatic entry into archive, the AO may authorize a manual logging system.
 - b) Monitoring personnel shall record the time, source, type of alarm, and action taken.
 - c) The SCIF SO shall routinely review the historical records.
 - d) Results of investigations and observations by the response force shall also be maintained at the monitoring station.
 - e) Records of alarm annunciations shall be retained for two years.
 - f) Shunting or masking of any zone or sensor shall be logged in the system archives.
 - g) All maintenance periods shall be archived into the system.
 - h) An archive shall be maintained for all remote service mode activities.
9. Access Control Systems Records which include:
 - a) The active assignment of ID badge/card, PIN, level of access, entries, and similar system-related information
 - b) Records of personnel removed from the system which shall be retained for two years from the date of removal.
10. Records of security incidents (violations/infractions) regarding automated systems shall be retained by the SO for five years from the date of an incident or until investigations of system violations and incidents have been resolved.

M. Emergency Plan

1. The SO shall create an emergency plan.
2. The emergency plan shall be approved by the AO and maintained on-site for each accredited SCIF.
3. The emergency plan may be an extension of an overall department, agency, or installation plan.
4. The emergency plan shall address the following:
 - Fire
 - Natural disaster
 - Civil unrest
 - Intrusion detection system failures
 - Admittance of emergency personnel into a SCIF
 - The protection of SCIF occupants and classified information

- Evacuation requirements and emergency destruction
5. Plans shall be reviewed at least annually and updated as necessary.
 6. All SCIF occupants shall be familiar with the plans and drills shall be conducted as circumstances warrant, but at least annually.
 7. Where political instability, terrorism, host country attitudes, or criminal activity suggests the possibility that a SCIF may be overrun, emergency plans shall include instructions for the secure destruction or removal of SCI under adverse circumstances and include contingencies for loss of electrical power and non-availability of open spaces for burning or chemical decomposition of material.
 8. Where the risk of hostile actions are significant, SCI holdings and reference materials shall be maintained at an absolute minimum required for current working purposes. If reference or other material is needed, it shall be obtained from other activities and returned or destroyed when no longer needed.

N. SCIF Co-Use and Joint Use

1. Any SCIF that has been accredited by an AO or designee shall be reciprocally accepted for use as accredited by all IC Elements when there are no waivers to the requirements established in ICS 705-1, ICS 705-2 and the IC Tech Specs.
2. Reciprocity is a condition that occurs when there is a requirement to share an accredited SCIF or a portion thereof with a compartment, program or special activity that is sponsored by an IC Element or organization other than the current SCIF CSA.
3. Reciprocal use requires a Co-Use (or Joint Use) agreement (CUA) which:
 - Identifies responsibilities of the tenant and host
 - Identifies the proposed use/activity
4. All CUA require completion of the SCIF Co-Use Request form.
5. CUA are considered Joint Use when the tenant desires to use the host information system.
6. CUA are routed through and approved by designated Co-Use Coordinators. These are the only individuals another Co-Use Coordinator will accept a CUA form from for processing.
7. The burden to initiate a CUA falls to the tenant. Information accuracy in the request is the responsibility of the tenant/host to facilitate; not the CUA coordinator.
8. CUA are NOT required when sharing a SCIF by two or more components under the cognizance of the same IC Element.

9. CUA are coordinated with the Information System security representatives if the tenant intends to bring an IT system into the host SCIF. Joint Use requires Information System security representative coordination as well.

O. CUA Form and Instructions

1. The following provides a guide on required information to ensure a CUA form is completed sufficiently and can be approved by both the tenant and host Co-Use Coordinators. Information accuracy on the form is the responsibility of the tenant and host mission areas to validate prior to the form being routed to the requesting (tenant) Co-Use Coordinator to initiate the approval process.
2. Overall classification of the CUA will usually be to the host security classification guide, unless the tenant mission is a higher classification.
3. All processing of a CUA should use the current form and be conducted on a classified system. Obtain the current CUA form from your agency Co-Use Coordinator. Legacy forms will not be accepted by the Co-Use Coordinator. Information necessary for a complete form includes:

- Block 1: Host Agency/Department

- Block 2: Tenant Agency/Department POC's (POC's are NOT the CUA Coordinator)

- Block 3: Provide complete and accurate information, to include the complete address and SCIF ID; this is how a coordinator validates information. Ensure the room numbers are accurate. This is important for IS installation. Site POC could be someone from host mission area or SO.

- Block 4: Ensure accuracy; one box must be checked.

- Block 5: Ensure accuracy; this is how a coordinator validates information.

- Block 6: This is the Host Information Security POC. Ensure the Co-Use or Joint Use categories and use criteria is accurate and clarified with Tenant/Host before the form is filled out.

- Block 7: Ensure all required information is filled out for an Industry site. Most Government locations are "Indefinite", however IC Elements AO or Designee may have designated time limits.

- Block 8: Most instances are "Intel Related". If you check "Other" ensure that a full and thorough description is provided in Block 9.

-Block 9: Ensure any information is clarified and input here; don't use for "filler". Classify as needed and portion mark properly.

-Tenant/Host Concur Blocks: Do NOT digitally sign; these are for CUA Coordinator use.

-Classification Block: Ensure the document is classified properly and this block is filled out properly; most likely to the Host classification guides.

P. CUA Cancellation

1. When a CUA is no longer desired or necessary a CUA cancellation form is required.
2. The burden to initiate the CUA cancellation form falls to the tenant.
3. The following provides a guide on required information to ensure a CUA cancellation form is completed sufficiently.

-Block 1: Host Agency/Department

-Block 2: Tenant Agency/Department POC's (POC's are NOT the CUA Coordinator)

-Block 3: Provide complete and accurate information, to include the complete address of the facility hosting the CUA/JUA

-Block 4: Ensure the SCIF ID is accurate.

-Block 5: Ensure the room numbers are accurate. This is important for IS removal (if applicable).

-Block 6: Ensure any pertinent information is clarified and input here.

-Tenant CUA Coordinator will digitally sign and date

-Classification Block: Ensure the document is classified properly and this block is filled out properly.

Chapter 13. Forms and Plans

Fixed Facility Checklist
TEMPEST Checklist
Compartmented Area Checklist
Shipboard Checklist
Submarine Checklist
Aircraft/UAV Checklist
SCIF Co-Use Request and MOA
SCIF Co-Use Request Users Guide
Cancellation of SCIF Co-Utilization or Joint-Utilization
Pre-Construction Checklist
Construction Security Plan (CSP)
Inspectable Materials Checklist

This page intentionally left blank.

SCIF Fixed Facility Checklist V1.5

FFC Date:

CLASSIFY ACCORDING TO CLASSIFICATION AUTHORITY

CHECK Applicable blocks		
<input type="checkbox"/> Domestic	<input type="checkbox"/> Overseas Not COM	<input type="checkbox"/> Overseas COM
<input type="checkbox"/> Pre-construction, Complete Sections as Required by A/O	<input type="checkbox"/> Final FFC Accreditation	<input type="checkbox"/> Update/Page Change

Checklist Contents

Section A: General Information

Section B: Security-in-Depth

Section C: SCIF Security

Section D: Doors

Section E: Intrusion Detection Systems (IDS)

Section F: Telecommunication Systems and Equipment Baseline

Section G: Acoustical Protection

Section H: Classified Destruction Methods

Section I: Information Systems/TEMPEST/Technical Security

List of Attachments

Section A: General Information

1. SCIF Data

Accrediting Agency	
Organization/ Company Name	
SCIF Identification Number <i>(if applicable)</i>	
Organization subordinate to <i>(if applicable)</i>	
Contract Number & Expiration Date <i>(if applicable)</i>	
Concept approval Date/by <i>(if applicable)</i>	
Accrediting Office/ Accrediting Individual's Name	/
Defense Special Security Communication System (DSSCS) Information <i>(if applicable)</i>	
DSSCS Message Address	
DSSCS INFO Address	
If no DSSCS Message Address, please provide passing instructions	

2. SCIF Location

Street Address			
Lat/Long <i>(If No Street)</i>		/	
Building Name			
Floor(s)	Suite(s)	Room(s) #	
City		Base/Post	
State/Country /			Zip Code

3. Mailing Address (if different from SCIF location)

Street or Post Office Box		
City	State	Zip Code

4. Responsible Security Personnel

	PRIMARY	ALTERNATE
Name		
Commercial Phone		
DSN Phone		
Secure Phone Type		
Cell		
Secure Fax		
Class Email		
Unclass Email		
Other Email		
Command or Regional Special Security Office/Name (SSO) <i>(if applicable)</i>		
Name		
Commercial Phone		
Other Phone		

5. Accreditation Data (Ref ICS 705-01, Para F.2 & ICS 705-02, Para D.1.a)				
a. Indicate storage requirement:		<input type="checkbox"/> Open	<input type="checkbox"/> Closed	<input type="checkbox"/> Continuous Operation
b. Indicate the facility type:		<input type="checkbox"/> Permanent	<input type="checkbox"/> Temporary	<input type="checkbox"/> Secure Working Area
c. Compartments of SCI Requested:				
d. Co-Use Agreements			<input type="checkbox"/> Yes	<input type="checkbox"/> No
e. SAP(s) co-located within SCIF			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, identify SAP Classification level (check all that apply)				
<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Confidential	
f. SCIF Duty Hours	Hours to Hours:	Days Per Week:		
g. Total square footage that the SCIF occupies:				
h. Does the facility have any approved waivers?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
<i>Provide attachment if required by AO</i>				
6. Construction/Modification (Ref: Chapter 3B)				
a. Is construction or modification complete?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If no, enter the expected date of completion:				
b. Was all construction completed in accordance with the CSP?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:				
7. Inspections (Ref: Chapter 12 G) (Provide attachment if required by AO)				
a. Has a TSCM Inspection been performed?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, provide the following:				
1) TSCM Service completed by:			On	
2) Were deficiencies corrected?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
3) If NO, explain:				
b. Last AO compliance periodic inspection/review:			On	
AO Office Name		AO Individual's Name		
c. Last self Inspection completed by:			On	
Were deficiencies corrected?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:				

8. REMARKS:

Section B: Security-in-Depth

1. Answer the questions in this section to describe your Security In Depth (Ref: Chapter 2B)

a. Is the SCIF located on a military installation, embassy compound, USG compound or contractor compound with a dedicated U.S. person response force?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Does the SCIF occupy an entire building	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Does the SCIF occupy a single floor of the building	<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Does the SCIF occupy a secluded area of the building	<input type="checkbox"/> Yes	<input type="checkbox"/> No
e. Is the SCIF located on a fenced compound with access controlled vehicle gate and/or pedestrian gate?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
f. Fence Type		
1) Height:		
2) Does it surround the compound?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
3) How is it controlled?		
4) How many gates (vehicle & pedestrian)?		
5) Hours of usage?		
6) How are they controlled when not in use?		
7) Is the Fence Alarmed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If so, describe alarm systems (i.e. - Microwave)		
g. Exterior Lighting Type:		
1) Fence Lighting		
2) Building Lighting		
h. Is there external CCTV coverage?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If so, describe the CCTV system. <i>(include monitor/coverage locations on map)</i>		
i. Exterior Guards	<input type="checkbox"/> Yes	<input type="checkbox"/> No
1) What kind of patrols are they?	<input type="checkbox"/> Static	<input type="checkbox"/> Roving
2) Clearance level of guards <i>(if applicable)</i>	<input type="checkbox"/> SCI <input type="checkbox"/> Top Secret <input type="checkbox"/> Secret	<input type="checkbox"/> None
3) During what hours/ days?		
4) Any SCIF duties?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, describe duties:		

2. Describe Building Security <i>(Please provide legible general floor plan of the SCIF perimeter)</i>				
a. Is the SCIF located in a controlled building with separate access controls, alarms, elevator controls, stairwell control, etc. required to gain access to building or elevator?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, is SCIF controlled by bldg owners?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If controlled by SCIF owners, is alarm activation reported to SCIF owners by agreement?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Construction Type				
c. Windows				
d. Doors				
e. Describe Building Access Control: Continuous?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If no, during what hours?				
f. Clearance level of guards <i>(if applicable)</i>		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret
1) Any SCIF duties?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, describe duties?				
During what hours/days?				
3. Describe Building Interior Security				
a. Are office areas adjacent to the SCIF controlled and alarmed?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, describe adjacent areas and types of alarm systems.				
b. Controlled by SCIF Owner?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If controlled by Bldg owner, alarm activation reported to SCIF owner by agreement?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
4. Remarks (Describe any additional security measures not addressed in this section)				
What external security attributes and/or features should the AO consider before determining whether or not this facility has Security In-Depth? Please identify/explain all factors:				

Section C: SCIF Security

1. How is access to the SCIF controlled (Ref: Chapter 8)

a. By Guard Force		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, what is their minimum security clearance level?		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret <input type="checkbox"/> Secret
b. Is Guard Force Armed?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
c. By assigned personnel?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, do personnel have visual control of SCIF entrance door?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. By access control device?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, what kind?		<input type="checkbox"/> Automated access control system <input type="checkbox"/> Non-Automated	
If Non-Automated			
1. Is there a by-pass key?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
If yes, how is the by-pass key protected?			
2. Manufacturer:		Model:	
<i>(Explain in Remarks if more space is required)</i>			
If Automated			
1. Is there a by-pass key?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
If yes, how is the by-pass key protected?			
2. Manufacturer:		Model:	
<i>(Explain in Remarks if more space is required)</i>			
3. Are access control transmission lines protected by 128-bit encryption/FIPS 140?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If no, explain the physical protection provided			
4. Is automated access control system located within a SCIF or an alarmed area controlled at the SECRET level?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
5. Is the access control system encoded and is ID data and PINs restricted to SCI-indoctrinated personnel?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
6. Does external access control outside SCIF have tamper protection?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
7. Is the access control device integrated with IDS		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
8. Is the access control device integrated with a LAN/WAN System?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
2. Does the SCIF have windows? (Ref: Chapter 3F)		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
a. Are they acoustically protected?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
If Yes, how: If No, explain:			
b. Are they secured against forced entry?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
If Yes, how: If No, explain:			
c. Do they have RF protection?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
If Yes, describe:			

2. SCIF windows (continued) (Ref: Chapter 3F)					
d. Are they protected against visual surveillance?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
If Yes, how: If No, explain:					
3. Do ventilation ducts penetrate the SCIF perimeter? (Ref: Chapter 3G)					
			<input type="checkbox"/> Yes	<input type="checkbox"/> No	
<i>(Indicate all duct penetrations and their size on a separate floor plan as an attachment)</i>					
a. Any ducts over 96 square inches that penetrate perimeter walls?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, how are they protected?		<input type="checkbox"/> Bars/Grills/Metal /Baffles	<input type="checkbox"/> Other as Approved by AO		
If Other, Describe Protection:					
b. Inspection ports?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	
■ If yes, are they within the SCIF?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	
■ If no, are they secured with AO approved High Security Lock?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If No, explain:					
c. Do all ventilation ducts penetrating the perimeter meet acoustical requirements?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	
<i>(NOTE: All ducts and vents, regardless of size may require acoustical protection)</i>					
■ If yes, how are they protected?		<input type="checkbox"/> Z-Duct	<input type="checkbox"/> Metal Baffles	<input type="checkbox"/> Noise Generator	<input type="checkbox"/> Other
If Other, Describe Protection:					
4. Construction (Ref: Chapter 3)					
a. Is the entire wall assembly finished from true floor to true ceiling?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	
b. Describe Perimeter Wall Construction:					
c. True ceiling					
Describe material and thickness:					
d. False ceiling?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	
1) If yes, what is the type of ceiling material?					
2) What is the distance between false and true ceiling?					
e. True floor					
Describe material and thickness:					
f. Raised floor?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	
1) If yes, what is the type of false flooring?					
2) What is the distance between raised and true floor?					

4. REMARKS:

Section D: SCIF Doors

The following door type definitions are referenced in this section: (Reference 3E)

- a. **Primary door:** A SCIF perimeter door recognized as the main entrance.
- b. **Secondary door:** A SCIF perimeter door employed as both an entry and egress door that is not the Primary door.
- c. **Emergency egress-only door:** A SCIF perimeter door employed as an emergency egress door with no entry capability.

1. Is the Primary door equipped with the following

- | | | |
|---|------------------------------|-----------------------------|
| a. A GSA-approved pedestrian door deadbolt meeting the most current version of Federal Specification FF-L-2890. NOTE: <i>Previously AO approved FF-L-2740 integrated locking hardware may be used. Additional standalone and flush-mounted dead bolts are prohibited.</i> | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|---|------------------------------|-----------------------------|

If NO, explain:

- | | | |
|--|------------------------------|-----------------------------|
| b. A combination lock meeting the most current version of Federal Specification FF-L-2740? NOTE: <i>Previously AO approved combination lock or deadbolt lock type may be used.</i> | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|--|------------------------------|-----------------------------|

If NO, explain:

- | | | |
|--|------------------------------|-----------------------------|
| c. Is an approved access control device installed? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|--|------------------------------|-----------------------------|

If NO, explain:

- | | | |
|--|------------------------------|-----------------------------|
| d. Is there a by-pass keyway for use in the event of an access control system failure? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|--|------------------------------|-----------------------------|

If NO, explain:

2. Secondary Door Criteria

Secondary doors may be established with AO approval and as required by building code, safety and accessibility requirements.

- | | | |
|---|------------------------------|-----------------------------|
| a. Does the SCIF have any approved Secondary doors? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|---|------------------------------|-----------------------------|

If Yes, are all approved Secondary doors equipped with the following:

- | | | |
|--|------------------------------|-----------------------------|
| 1) A GSA-approved pedestrian door egress device with deadbolt meeting the most current version of Federal Specification FF-L-2890 for secondary door use | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|--|------------------------------|-----------------------------|

If NO, explain:

- | | | |
|--|------------------------------|-----------------------------|
| 2) Approved access control hardware which must be deactivated when the SCIF is not occupied, or as determined by the AO. | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|--|------------------------------|-----------------------------|

If NO, explain:

- | | | |
|--|------------------------------|-----------------------------|
| b. Does the SCIF have any Emergency Egress-only doors? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|--|------------------------------|-----------------------------|

If Yes, do all approved Emergency Egress-only doors meet the following:

- | | | |
|--|------------------------------|-----------------------------|
| 1) Are they installed as required by building code, safety and accessibility requirements? | <input type="checkbox"/> Yes | <input type="checkbox"/> No |
|--|------------------------------|-----------------------------|

If NO, explain:

Section D: SCIF Doors

2) Are they equipped with GSA-approved pedestrian door emergency egress device with deadbolt configuration meeting the most current version of Federal Specification FFL-2890 for exit only door use or an AO approved alternate device with similar functionality ?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:		
3) Are they alarmed 24/7 and have a local audible annunciator that must be activated if the door is opened?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:		
3. Criteria for ALL SCIF Doors (Ref: Chapter 3E)		
a. Do all SCIF perimeter doors comply with applicable building code, safety, and accessibility requirements as determined by the authority having jurisdiction?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:		
b. Does the SCIF SOP includes procedures to ensure all doors are secured at end of day3	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:		
c. Are all SCIF perimeter pedestrian doors equipped with an automatic, non-hold door-closer which shall be installed internal to the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:		
d. Are door hinge pins that are accessible from outside of the SCIF modified to prevent removal of the door, e.g., welded, set screws, dog bolts, etc?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:		
e. Do SCIF perimeter doors and frame assemblies meet acoustic requirements unless declared a non-discussion area?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:		
f. Are all SCIF perimeter doors alarmed in accordance with Chapter 7 of the Technical Specifications?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:		
g. Do all SCIF Perimeter doors meet TEMPEST requirements per CTTA guidance?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If NO, explain:		
4. Describe SCIF door fabrication and unique criteria		
a. Wooden SCIF doors are at least 1 ¾ inch-thick solid wood core (i.e. wood stave, structural composite lumber).	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> N/A		

Section D: Doors

b. Steel doors have the following specifications: 1) 1 ¾ inch-thick face steel equal to minimum 18-gauge steel. 2) Hinges reinforced to 7-gauge steel and preferably a lift hinge. 3) Door closure installation reinforced to 12-gauge steel. 4) Lock area pre-drilled and/or reinforced to 10-gauge steel.	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
c. Vault door are GSA-approved Class 5 and not used to control day access.	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
d. Roll-up Doors are a minimum 18-gauge steel, secured inside the SCIF using dead-bolts on both sides of the door and alarmed in accordance with Chapter 7	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
e. SCIF perimeter Double Doors have the following specifications: 1) The fixed leaf shall be secured at the top and bottom with deadbolts. 2) An astragal shall be attached to one door. 3) Each leaf of the door shall have an independent security alarm contact.	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
f. Adjacent SCIF adjoining doors specifications 1) Be dead bolted on both sides 2) Be alarmed on both sides according to chapter 7. 3) Meet acoustic requirements as required. 4) Be covered by AO standard operating procedures. 5) Other door types shall be addressed on an individual basis as approved by the AO.	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A

5. REMARKS:

Section E: Intrusion Detection Systems

1. General IDS Description (Ref: Chapter 7A)

a. Has the IDS configuration been approved by the AO?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. IDS installed by: 		
c. Premise Control Unit (PCU)		
Manufacturer		Model Number
Tamper Protection		<input type="checkbox"/> Yes <input type="checkbox"/> No
d. Is the PCU located inside the SCIF perimeter (indicated on floor plan)?		<input type="checkbox"/> Yes <input type="checkbox"/> No
If no, explain 		
e. Accessible points of entry/perimeter?		<input type="checkbox"/> Yes <input type="checkbox"/> No
Any others? Explain;		
f. Has the IDS passed AO or UL 2050 installation and acceptance tests?		<input type="checkbox"/> Yes <input type="checkbox"/> No
<i>If yes, attach a copy of certificate (Non-commercial proprietary system must answer all questions)</i>		
g. High Security Switches Type I		<input type="checkbox"/> Yes <input type="checkbox"/> No
h. High Security Switches Type II		<input type="checkbox"/> Yes <input type="checkbox"/> No
i. Motion sensor		
j. Are any other intrusion detection equipment sensors/detectors in use?		<input type="checkbox"/> Yes <input type="checkbox"/> No
<i>Please identify make, model and manufacturer and function and the location of interior motion detection protection(indicate on floor plan)</i>		
Make	Model	Manufacturer
		
		Function
		
k. Does the IDS extend beyond the SCIF perimeter?		<input type="checkbox"/> Yes <input type="checkbox"/> No
If yes, explain. 		
l. Can the status of PCU be changed from outside IDS protection?		<input type="checkbox"/> Yes <input type="checkbox"/> No
If yes, is an audit conducted daily?		<input type="checkbox"/> Yes <input type="checkbox"/> No
m. Do any intrusion detection equipment components have audio or video capabilities?		<input type="checkbox"/> Yes <input type="checkbox"/> No
If yes, explain. 		
n. PCU administrator SCI indoctrinated?		<input type="checkbox"/> Yes <input type="checkbox"/> No
o. Is external Transmission Line Security used?		<input type="checkbox"/> Yes <input type="checkbox"/> No
If yes, explain. 		
p. What is the method of line security? National Institute of Standards and Technology (NIST) FIPS AES encryption?		<input type="checkbox"/> Yes <input type="checkbox"/> No

1) If yes, has the encryption been certified by NIST or another independent testing laboratory?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
2) If not NIST standard, is there an alternate?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, explain.			
3) Does the alternate line utilize any cellular or other Radio Frequency (RF) capability?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Manufacturer		Model Number	
q. Does any part of the IDS use local or wide area network (LAN/WAN)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
1) Is the host computer dedicated solely for security purposes?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
2) Is the host computer secured within an alarmed area at the physically or higher level protected spaces or higher level?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
3) Is the host computer protected through firewalls or similar devices?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
4) Is the password for the host computer unique for each user and at least 8-characters long consisting of alpha, numeric, and special characters?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
5) Is the password changed semi-annually?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
6) Are remote security terminals protected the same as the host computer?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
If no, explain:			
2. Is emergency power available for the IDS?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
Generator?	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, how many hours?	
Battery?	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, how many hours?	
3. Who monitors is the IDS alarm monitor station and where is it located?			
a. Has the IDS alarm monitor station been installed to Underwriters Laboratories certified standards?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<i>Contractor facility submit copy of Certificate</i>			
4. Does the monitor station have any remote capabilities (i.e., resetting alarms, issuing PINs, accessing/securing alarms, etc.?)		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
If yes, explain:			
5. Does the IDS have any automatic features (i.e., timed auto-secure, auto-access capabilities?)		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
6. Does the PCU/keypad have dial out capabilities?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
7. IDS response personnel		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
a. Who provides initial alarm response?			
b. Does the response force have a security clearance?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
■ If yes, what is the clearance level?		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret <input type="checkbox"/> Secret
c. Do you have a written agreement with external response force?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Emergency procedures documented?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
e. Response to alarm condition:		Minutes	
f. Are response procedures tested and records maintained?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If no, explain:			

g. Has a catastrophic failure plan been approved by the AO?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div>■ If no, explain:</div>		
<div>10. REMARKS:</div>		

Section F: Telecommunication Systems and Equipment Baseline

1. Does the facility have any unclassified telephones that are connected to the commercial public switch telephone network (PSTN)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Identify the method of on-hook protection by completing items below			
NOTE: TSG 6 approved phones can be found at the following link: https://www.dni.gov/files/NCSC/documents/products/TSG-Approved-Equipment-List-May-2017.pdf			
a. CNSSI 5006 (TSG-6) approved telephone or instrument		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
<i>(Please identify all telephone equipment/stations and/or instruments being used either below or as an attachment)</i>			
Manufacturer	Model Number	TSG Number (if applicable)	
b. CNSSI 5006 (TSG-6) approved disconnect device?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
1) Line disconnect?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
2) Ringer protection?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
Manufacturer	Model Number	TSG Number (if applicable)	
c. CNSSI 5002 (TSG-2) configured computerized telephone system (CTS)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
1) If yes, please provide the following information about the CTS			
Manufacturer		Model	
2) If yes, please provide the location of the CTS			
3) Does the Physically Protected Space (PPS) meet equivalent security and access control standards as the supported SCIF?"		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div style="background-color: #cccccc; padding: 5px;">■ If no, explain?</div>			
4) How are all cables, signal lines and intermediate wiring frames between the SCIF telephones and the CTS physically protected within a physically controlled space?			
5) Are all program media, such as tapes and/ or disks, from the CTS afforded physical protection from unauthorized alterations?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
6) Is an up-to-date master copy of the CTS software program maintained for confirmation and/ or reloading of the operating system?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
7) Does the CTS have the capability to force or hold a telephone station off-hook?		<input type="checkbox"/> Yes	<input type="checkbox"/> No

8) Does the CTS use remote maintenance and diagnostic procedures or other remote access features?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> If yes, explain maintenance procedures				
9) Do the CTS installers and programmers have security clearances?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> If yes, at what access level (minimum established by AO)		<input type="checkbox"/> Secret	<input type="checkbox"/> Top Secret	<input type="checkbox"/> SCI
<input type="checkbox"/> If no, are escorts provided?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Is it a Voice over Internet Protocol (VOIP) phone system (IPS) (Ref CNSSI 5000)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
1) If yes, please provide the following information about the IPS				
Manufacturer	Model Number	IPS Location		
2) Do all unclassified telephones within the facility have a hold, mute and/or push-to-talk [handset] capability, (for off-hook audio protection)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
<input type="checkbox"/> If no, explain?				
3) Is access to the facility housing the IPS physically controlled?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> If yes, what is the clearance level (if any) of facility or area where the switch is located and how is the area controlled?		<input type="checkbox"/> Secret	<input type="checkbox"/> Top Secret	<input type="checkbox"/> SCI
<input type="checkbox"/> If no facility clearance level how is the facility or area where the IPS is physically located controlled				
4) Are all cables, signal lines and intermediate wiring frames between the SCIF telephones and the IPS physically protected or contained within a physically controlled space?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input type="checkbox"/> If no, explain?				
5) Are all program media, such as tapes and/or disks, from the IPS afforded physical protection from unauthorized alterations?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
6) Is an up-to-date master copy of the IPS software program maintained for confirmation and/or reloading of the operating system?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
7) Does the IPS have the capability to force or hold a telephone station off-hook?			<input type="checkbox"/> Yes	<input type="checkbox"/> No

8) Does the IPS use remote maintenance and diagnostic procedures or other remote access features?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
9) Do the IPS installers and programmers have security clearances?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
■ If yes, at what access level (minimum established by AO)?		<input type="checkbox"/> Secret	<input type="checkbox"/> Top Secret	<input type="checkbox"/> SCI	
■ If no, are escorts provided?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
2. Automatic telephone call answering					
a. Are there any automatic call answering devices for the telephones in the SCIF?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
1) If yes, please identify the type					
■ Voicemail/ unified message service?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
■ Standalone telephone answering device (TAD)?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
2) Provide manufacturer and model number of the equipment					
Manufacturer			Model		
b. Are speakerphones/ microphones enabled?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
■ If yes, has the remote room monitoring capability been disabled?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
■ Has this been approved for use by the AO?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
Provide detailed configuration procedures					
■ If applicable, is the voice mail or unified messaging services configured to prevent unauthorized access from remote diagnostic ports or internal dial				<input type="checkbox"/> Yes	<input type="checkbox"/> No
3. Are any multi-function office machines (M-FOMs) used within the SCIF (M-FOMs are electronic equipment that can be used at network or standalone printers, facsimiles, and copiers)?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
a. If yes, please identify the device to include (Please identify all M-FOM devices in use, either below or as an attachment) – Include a manufacture Volatile statement for each M-FOM.					
Make		Model		Serial Number	
b. If yes, please identify all features and information processing level of each M-FOM					
1) Copier ?				<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
■ If yes, level(s) of information		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified
2) Facsimile?				<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
■ If yes, level(s) of information		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified
3) Printer? (connected to a standalone computer or network)				<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
■ If yes, please explain and identify the system(s) and the level(s) of information					
System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified
System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified
System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified

c. Does the M-FOM have memory storage capability?				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
If yes, what kind?		<input type="checkbox"/> Volatile (information in memory clears/ erases when powered off)		<input type="checkbox"/> Non-volatile (information in memory that remains when powered off)		
d. Does the M-FOM have a digital hard drive?				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
e. Have maintenance and disposition procedures been established?				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
f. Does the M-FOM have voice transmission capability and/ or a telephone handset?				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
<input checked="" type="checkbox"/> If yes, describe how is this feature protected?						
4. Are there any video teleconference (VTC) systems installed?					<input type="checkbox"/> Yes	<input type="checkbox"/> No
<input checked="" type="checkbox"/> If yes, what level(s) of information is the VTC system processing?		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified	
Which room(s) contain VTC systems?						
5. Are there any commercial television receivers installed?					<input type="checkbox"/> Yes	<input type="checkbox"/> No
<i>If yes, provide a separate annotated floor plan of the commercial television system</i>						
6. Does the SCIF have any automated environmental infrastructure systems?					<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, describe what countermeasures have been taken to provide against malicious activity, intrusion, and exploitation. (Example: premise management systems, environmental control systems, lighting and power control units, uninterrupted power sources)						
7. REMARKS:						

Section G: Acoustical Protection

1. Do all areas of the SCIF meet AO required acoustical protection standards”? (Ref: Chapter 9A)		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>■ If no, describe additional measures taken to provide conforming acoustical protection (e.g., added sound insulation, door and windows coverings, no discussion areas, sound masking, etc.)</p>			
2" Is the facility declared a “No Classified Discussion Area”? (Ref: Chapter 11A)		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>■ If yes, then the audio protection questions within this section may be identified as N/A</p>			
<p>■ If the facility is declared a "No Classified Discussion Area,"are warning notices posted prominently within the facility?</p>		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/ A
3. Are there any amplified audio systems used for classified information? (Example VTC, PA systems, etc.)		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p>■ If yes, are the walls/ ceilings/ floor of the room where the amplified audio system resides acoustically treated to meet a Sound Group 4 or STC 50?</p>		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/ A
4. Is there a public address, music system or white noise system entirely contained within the SCIF		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<p><i>If yes, provide a separate annotated floor plan for each system and describe the protection provided to the system (fiber isolation, self-amplified speakers, other method to ensure no audio back feed from the system, etc.)</i></p>			
5. Is the SCIF equipped with a public address, emergency/fire announcement or music system originating outside the SCIF?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
6. REMAKS:			

Section H: Classified Destruction Methods

1. Destruction methods? (Ref: Chapter 12M)

a. Describe the method and equipment used for destruction of classified/ sensitive material (if more than one method or device, use Remarks to describe). List all manufacturer and models

Method	Device Manufacturer	Model

b. Is a secondary method of destruction available? ☐ Yes ☐ No

c. Describe the location of destruction site(s) in relation to the secure facility

d. Describe method or procedure used for handling non-soluble classified/ sensitive material at this facility

e. Do you have a written Emergency Action Plan (EAP) approved by AO (if required)? ☐ Yes ☐ No ☐ N/ A

2. REMARKS:

Section I: INFOSEC/TEMPEST/Technical Security

1. Does the facility electronically process classified information? (Ref: Chapter 13) ☐ Yes ☐ No

■ If yes, complete TEMPEST CHECKLIST FOR SCIF Form

CLASSIFICATION

SCIF TEMPEST Checklist

Organization Name: FFC Date: **CLASSIFY ACCORDING TO CLASSIFICATION AUTHORITY**

Checklist Contents

Section A: General Information**Section B: SCIF Equipment/Systems****Section C: Information Processing****Attachments****NOTE: Maps – Include Compass with True North indicated****External Map**

1. Scale Drawing of SCIF location within the base/post/compound city of its location.
 - a. If you are on a military base/post, a government controlled facility/area or a compound/campus that is solely controlled by your company with a 24-hour guard force, indicate the following:
 - i. Distance between the building and the closest boundary of the compound in meters.
 - ii. Distance in meters to the boundaries in each cardinal direction (i.e. East, West, North and South).
 - iii. Scale drawings or maps of the location of the post/base/facility/area/campus/compound in relationship to the nearest city.
 - b. If you are not in a controlled area indicate the following:
 - i. Distances in meters from the SCIF perimeter to the closest limit of SCIF's inspectable space boundary
2. Show the locations of any areas within 100 meters of the SCIF which are occupied by Foreign Nationals or controlled by Foreign Entities/Companies that are not readily accessible by SCIF personnel

Internal Map

1. Scale drawings or maps of the location of your SCIF within the building or facility that it resides
2. Provide floor plans of the SCIF itself and provide the following:
 - a. Location and identify by manufacture, model, type, and level of classification of any equipment that is electronically processes unencrypted National Security Information (NSI). For large facilities, this list can be placed on a separate spread sheet and numbers/symbols can be used in the drawing.
 - b. Location of all Signal Line Distribution Systems, telephone instruments, line and power filters and/or isolators, signal ground points, etc...
 - c. Routing and identity of lines, cables and other metallic conductors which leave the SCI area, including telephone, power, signal, alarm lines, pipes, air ducts, etc..
3. If the SCIF is located in a Multi-story building NOT entirely controlled by the US government, include the following:
 - a. Floor plan of the entire floor and identify the occupants of the other spaces.
 - b. Provide the names of the occupants on the floors above and below.
 - c. Identify any foreign nationals.

NOTE: GSA facilities are not exempt from the above requirement.

4. Indicate whether the SCIF shares a common wall with any non-government organizations. If so, list them and show their locations on the diagram and maps.
5. Indicate identity of all signal lines and signal distribution systems within the SCIF.
 - a. Identify them as BLACK or RED and include all telephone lines, signal lines, alarm lines, etc.
 - b. If applicable, indicate where they leave the SCIF area.
 - c. Indicate where they leave the SCIF how the locations of all filters, Isolators and amplifiers

CLASSIFICATION

01 14 00AT1

CUI

CLASSIFICATION

Section A: General Information

1. SCIF Data

Organization/Company Name	
SCIF Identification Number <i>(if applicable)</i>	
Organization subordinate to <i>(if applicable)</i>	
Contract Number & Expiration Date <i>(if applicable)</i>	
Concept approval Date/by <i>(if applicable)</i>	
Cognizant Security Authority (CSA)	CSA
Defense Special Security Communication System Information <i>(if applicable)</i>	
DSSCS Message Address	
DSSCS INFO Address	
If no DSSCS Message Address, please provide passing instructions	

2. SCIF Location

Street Address		Building Name	
Floor(s)	Suite(s)	Room(s) #	
City		Base/Post	
State/Country ST /		Zip Code	

3. Mailing Address (if different from SCIF location)

Street or Post Office Box		
City	State ST	Zip Code

4. Responsible Security Personnel

	PRIMARY	ALTERNATE
Name		
Commercial Phone		
DSN Phone		
Secure Phone		
STE Other Phone		
Home		
Secure Fax		
Command or Regional Special Security Office/Name (SSO) <i>(if applicable)</i>		
Commercial Phone		
Other Phone		

CLASSIFICATION

5. E-Mail Address of Responsible Security Personnel			
Classified		Network/System Name & Level	
Unclassified		Network/System Name	
Other		Network/System Name	
Section B: SCIF Equipment/Systems			
1. Signal Lines and Signal Distribution Systems			
<i>Provide a floor plan diagram that show the location, routing and identity of all signal lines and signal distribution systems within the SCIF. Identify them as BLACK or RED and include all telephone lines, signal lines, alarm lines, etc. If applicable, indicate where they leave the SCIF area and show the locations of all filters, Isolators and amplifiers.</i>			
a. Are there any Signal Lines/Signal Distribution systems that exit the SCIF?			<input type="checkbox"/> Yes <input type="checkbox"/> No
b. If No, skip to 2			
c. If Yes, what type of lines exit the SCIF?	d. <input type="checkbox"/> Fiber Optic (skip to 2)	e. <input type="checkbox"/> Coaxial	<input type="checkbox"/> Copper
f. If they are Coaxial or Copper wires, is there any kind of Filter or Isolation device installed on them?			<input type="checkbox"/> Yes <input type="checkbox"/> No
If Yes, what type of device is used in the system? <i>If needed, use additional sheets.</i>			
Make	Model #	Location	
If No, describe each Signal Lines/Signal Distribution Systems.			
Where it does each Signal Lines/Signal Distribution Systems go?			
What does each Signal Lines/Signal Distribution Systems connect to outside the SCIF?			
What is the composition of line?			
How many lines			
Additional Information			

2. Power Lines and Power Distribution Systems

a. Are there any Power Lines/Power Distribution Systems that exit the SCIF	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If Yes, provide a diagram showing where it exits the SCIF. If No, skip to item 3.		
b. Where do the power lines leave the SCIF		
c. What does the power line connect to outside the SCIF		
d. Does the power come from a host nation source	<input type="checkbox"/> Yes	<input type="checkbox"/> No
e. Does the power come from a US controlled generator	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Describe the material composition of the line, the number of lines and the voltages involved		

3. Heating, Ventilation and Air Conditioning (HVAC) Systems; Water Pipes; Gas Pipes, Sprinkler Systems, etc.

<i>Provide a diagram indicating their exits from the SCIF. If there are any grounding mitigations, please indicate on the diagram. Are wave guides installed?</i>		
Do ventilation ducts/pipes penetrate the SCIF perimeter? (Ref: Chapter 3G)	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Describe each HVAC Systems or pipe. Please explain in detail: path, connections in/outside of the SCIF, composition of the vent or pipe, size, accessibility, etc.:		
Are there any grounding mitigations?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If Yes, describe:		
Are any wave guides installed	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If Yes, describe:		

4. Radio Transmission/Reception Device:			
<i>Submit floor plans of the SCIF showing the transmitter locations, signal and power line routing and the identity of all system components installed within the SCIF. If applicable, indicate where they leave the SCI area, where the antenna is and show the locations of all Isolators and filters.</i>			
a. Are there any Radio Transmitters or Receivers located in the SCIF or within three meters of the SCIF's perimeter wall? If No, skip to 5			<input type="checkbox"/> Yes <input type="checkbox"/> No
Device #1:			
a) Type Equipment		Make	Model
b) Hours Used	<input type="checkbox"/> Per Month <input type="checkbox"/> Per Week <input type="checkbox"/> Per Day		
c) Prior to encryption, highest classification of information transmitted	<input type="checkbox"/> SCI <input type="checkbox"/> Top Secret <input type="checkbox"/> Secret		
d) Location (Rm#)			
e) List the distance between the radio transmission/reception device and the nearest RED equipment or crypto gear			
f) Is the power for the radio transmission/reception equipment isolated from the power for the RED processing equipment			<input type="checkbox"/> Yes <input type="checkbox"/> No
If Yes, how are they isolated		<input type="checkbox"/> Separate power circuit (<i>Skip to 5.</i>) <input type="checkbox"/> Power line filters (<i>annotate in 2d.</i>)	
If No, describe each transmitter power source			
Transmitter power source path			
Transmitter power source connections in/out of the SCIF			
Transmitter power source composition of the line			
Transmitter power source voltage			
Transmitter power source size/gauge			
Transmitter power sources accessibility			
Additional transmitter power source information			
For Additional Devices (<i>use additional sheets</i>)			

Use Fixed Facility Checklist “Section F: Telecommunication Systems and Equipment Baseline” to answer items 5 and 6.

5. Multilevel Systems:

Are there any multi-level systems (e.g, equipment that processes different classification levels) located in the SCIF or within one meter of the SCIF’s perimeter wall?

6. Telecommunications Systems:

What kind of telecommunications systems are in the SCIF? (VoIP, DSM) Please describe.

7. Existing TEMPEST

a. List any existing TEMPEST countermeasures

1) Are there any shielded enclosures? ☐ Yes ☐ No

If Yes, describe.

2) Is there any supplemental shielding? ☐ Yes ☐ No

If Yes, describe.

3) Are there any filters (power, signal, telephone, etc...) ☐ Yes ☐ No

If Yes, describe.

4) Are there any non-conductive sections in metallic distribution systems (pipes, a/c ducts, etc.)? ☐ Yes ☐ No

If Yes, describe.

b. Construction method and materials

1) Describe Perimeter Wall Construction:

2) Ceiling

True ceiling? ☐ Yes ☐ No

If Yes, What is the material and thickness:

False ceiling? ☐ Yes ☐ No

If yes, what is the type of ceiling material?

What is the distance between false and true ceiling?			
3) Floor			
True floor ?			<input type="checkbox"/> Yes <input type="checkbox"/> No
If Yes, What is the material and thickness:			
False floor?			<input type="checkbox"/> Yes <input type="checkbox"/> No
If yes, what is the type of false flooring?			
What is the distance between false and true floor?			
c. Windows			
1) Does the SCIF have windows			<input type="checkbox"/> Yes <input type="checkbox"/> No
Quantity:		Size:	
Countermeasures:			
Section C: Information Processing			
<i>Volume of Information Processed- Describe the percentage and volume of information processed at the UNCLASSIFIED, SENSITIVE, CONFIDENTIAL, SECRET, and TOP SECRET levels.</i>			

CLASSIFICATION

SCIF Compartmented Area (CA) Fixed Facility Checklist

CHECK Applicable blocks		
<input type="checkbox"/> Initial Approval	<input type="checkbox"/> Re-approval	<input type="checkbox"/> Modified Facility
<input type="checkbox"/> Pre-construction	<input type="checkbox"/> New Facility	<input type="checkbox"/> Page Change

Checklist Contents

Section A: **General information**

Section B: **Compartmented Area Security**

Section C: **Compartmented Area Type Descriptions**

List of Attachments

(Diagrams must be submitted on 8 ½" x 11" or 11" x 17" format)

CLASSIFICATION

01 14 00AT1
CUI

CLASSIFICATION

Section A: General Information**1. SCIF Data**

<i>Organization/Company Name</i>			
<i>SCIF Identification Number (if applicable)</i>			
<i>Organization subordinate to (if applicable)</i>			
<i>Cognizant Security Authority (CSA)</i>			
<i>Defense Special Security Communication System Information (if applicable)</i>			
<i>DSSCS Message Address</i>			
<i>DSSCS INFO Address</i>			
<i>If no DSSCS Message Address, please provide passing instructions</i>			
<i>Contract Information:</i>	<i>Contract #</i>	<i>Expiration Date</i>	

2. Location of Proposed Compartmented Area

<i>Street Address</i>		<i>Building Name</i>	
<i>Floor(s)</i>	<i>Suite(s)</i>	<i>Room(s) #</i>	
<i>City</i>		<i>Base/Post</i>	
<i>State/Country ST</i>		<i>Zip Code</i>	

3. Mailing Address (if different from SCIF location)

<i>Street or Post Office Box</i>		
<i>City</i>	<i>State ST</i>	<i>Zip Code</i>

4. Responsible Security Personnel

	<i>PRIMARY</i>	<i>ALTERNATE</i>
<i>Name</i>		
<i>Commercial Phone</i>		
<i>DSN Phone</i>		
<i>Secure Phone</i>		
<i>STE Other Phone</i>		
<i>Home</i>		
<i>Secure Fax</i>		
<i>Command or Regional Special Security Office/Name (SSO)</i>		
<i>ISSO</i>		
<i>Commercial Phone</i>		
<i>Secure Phone</i>		

CLASSIFICATION

01 14 00AT1
CUI

CLASSIFICATION

5. Existing SCIF Accreditation Data

a. Type					
<input type="checkbox"/> Open Storage	<input type="checkbox"/> Closed Storage	<input type="checkbox"/> IT Processing	<input type="checkbox"/> Discussions	<input type="checkbox"/> Continuous Operation	<input type="checkbox"/> Fixed <input type="checkbox"/> TSWA <input type="checkbox"/> SWA <input type="checkbox"/> Other
b. Accreditation Granted by:			on:		
c. If automated information system (AIS) is used, has an accreditation been granted?					<input type="checkbox"/> Yes <input type="checkbox"/> No
If yes, identify compartment classification level (check all that apply)					
<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Confidential		
d. SCIF Duty Hours	Hours to Hours:		Days Per Week:		
e. Total square footage that the SCIF occupies:					
f. Any waivers? (If Yes, attach copy of approved waiver)					<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A

6. Requestor Contact Information

Name				
Phone	Open		Secure	
Email	Unclass		Classified	
Additional Email	Unclass		Classified	

7. Compartmented Area Information

a. Compartmented area accreditation level desired:				
1) Indicate CA requirements				
<input type="checkbox"/> Open Storage	<input type="checkbox"/> Closed Storage	<input type="checkbox"/> IT Processing	<input type="checkbox"/> Discussions	<input type="checkbox"/> Continuous Operation
2) Indicate the CA Type Requested (See Section C)				
<input type="checkbox"/> Type 1		<input type="checkbox"/> Type 2		<input type="checkbox"/> Type 3

Section B: Compartmented Area Security**1. Equipment Processing**

Are all equipment (computers, copiers, printers, scanners, fax, etc.) used to process compartmented information approved to process compartmented program information or a system security plan (SSP) submitted for approval to the appropriate information system authorizing official?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<i>Provide a copy of the approval documentation or a copy of the SSP submitted.</i>		

2. Workstations in a cubicle or office configuration – Type 1:

a. Is the CA in a cubicle or other open environment?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Is the workstation in a closable office?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. If the office is closable, is there an access control device?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, please provide the following:	MANUFACTURER	MODEL
d. Are display screens positioned to avoid “shoulder-surfing”?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
e. Are polarized privacy screens installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
f. Is printing of CA material required?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, explain printer location, connectivity and procedures to retrieve printed material.		

CLASSIFICATION

01 14 00AT1
CUI

CLASSIFICATION

g. Is scanning/copying of CA material required?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, explain copier/scanner location, connectivity and procedures to protect CA material.			
h. Is storage of CA material required within the CA?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, do only individuals briefed to the CA program have access to the GSA approved storage container?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
i. Describe procedures to secure the workstation when the individual leaves the CA (for any length of time).			
j. Describe procedures to secure the CA at the end of day.			
3. CAs with a requirement for discussions of compartmented information Type 2:			
a. Are all individuals within the CA briefed to the compartment?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If No, describe procedures to prevent inadvertent disclosure of compartmented information.			
b. Is the CA constructed to meet ICS 705-1 acoustic standards?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If Yes, describe acoustic protection method used.			
c. Is secure teleconferencing equipment to be used?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Describe the procedures for controlling access during program discussions and control of meeting material used (if applicable) during and after the discussions.			
4. CAs with a requirement for strict accountability of compartmented information – Type 3:			
a. Are all personnel who have unescorted access to the CA briefed to the compartmented program?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Does the CA meet ICS 705-1 standard for acoustic protection? (if applicable)		<input type="checkbox"/> Yes	<input type="checkbox"/> No
If Yes, describe acoustic protection method used.			
c. Are storage containers GSA approved?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Are all equipment (computers, copiers, printers, scanners, fax, etc.) used to process compartmented information approved or a system security plan (SSP) submitted for approval?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
5. Controlling Access to Program Information			
Describe the procedures for controlling access during program discussions and control of meeting material used (if applicable) during and after the discussions. In addition, include any remarks to assist in the approval process.			

CLASSIFICATION

CLASSIFICATION

6. Additional security measures (locks, alarms, dedicated reading rooms, etc.) are considers waivers (above) to the standards and require approval of the IC Element Head. Identify any additional security requirements requested:

Section C: Compartmented Area Type Descriptions

1. Compartmented Area Types

Type I: A workstation environment that is used to view and process compartmented information.

Type I comprises open bays, open spaces, or a set of rooms with multiple cubicles in an accredited SCIF where compartmented information may be securely viewed and/or processed, i.e., via an approved computer workstation by authorized personnel. Workstations in these environments may include computers with single or multiple monitors. Polarized privacy screens may be used on a computer monitor to prevent persons other than the authorized user to view the material, i.e., shoulder surfing, or when a monitor faces a primary door or common work area. In addition to processing compartmented information on approved computer workstations, Type I CAs may include the use of printers, copiers, and scanners with prior approval.

Type II: An area where discussions of compartmented information may take place. If so equipped and approved, compartmented information may also be viewed and processed.

This CA comprises a room, e.g., office or conference room, inside an accredited SCIF where compartmented discussions may be held by authorized personnel. All Type II CAs must meet existing sound transmission class (STC) requirements per ICS 705-1 to ensure that the room or office retains sound within its perimeter. In addition to compartmented discussions, Type II CAs may be used for secure video teleconferencing (SVTC) and related communication conferencing and the use of secure telephones for compartmented discussions. The use of printers, scanners, and copiers, and the secure transfer of data to approved removable media or and the use of secure facsimile machines require prior approval.

Type III: A restricted discussion area used for viewing, processing, printing, copying, storage and control of accountable compartmented information.

This CA is intended for storing and retaining compartmented information when accountability and strict control of compartmented program information is required. This includes, but is not limited to: notes, briefs, slides, electronic presentations, analytic papers, removable hard drives, field packs, thumb drives, laptops, personal electronic devices (PEDs) or hand-held devices that store compartmented information. In addition to the storage of compartmented material in a GSA-approved container, Type III CAs may be used for processing compartmented information on approved computer workstations; the use of printers, scanners, and copiers; the secure transfer of data to approved removable media; the use of secure facsimile machines; and the use of secure telephone equipment (STE) for compartmented discussions. All personnel residing within or who have unfettered access to a Type III CA must be formally briefed into all compartments that reside within the Type III CA. Visitors are permitted within Type III areas only when all compartmented information (for which the visitor is not briefed) is stored within containers, out of sight, and while the visitor is under constant observation by a fully briefed person.

CLASSIFICATION

01 14 00AT1
CUI

SHIPBOARD

SCIF Fixed Facility Checklist

Organization Name:
FFC Date:

CLASSIFY ACCORDING TO CLASSIFICATION AUTHORITY

CHECK Applicable blocks		
<input type="checkbox"/> Initial Accreditation	<input type="checkbox"/> Re- Accreditation	<input type="checkbox"/> Modified Facility
<input type="checkbox"/> Pre-construction	<input type="checkbox"/> Final FFC Accreditation	<input type="checkbox"/> Page Change

Checklist Contents

Section A: General information

Section B: Security-in-Depth

Section C: Intrusion Detection Systems (IDS)

Section D: Telecommunication Systems and Equipment Baseline

Section E: Classified Destruction Methods

Section F: TEMPEST/Technical Security

List of Attachments

(Diagrams must be submitted)

Section A: General Information

1. SCIF Data

a. Organization/Company Name	
b. Name of Ship and Hull number	
c. Home Port	
d. SCIF ID Number	
e. Contract Number and Expiration	
f. Date (if applicable)	
g. Concept Approval Date	
h. Cognizant Security Authority (CSA)	
Defense Special Security Communication System Information (if applicable)	
i. DSSCS Message Address	
j. DSSCS INFO Address	
k. If no DSSCS Message Address, please provide passing instructions	
l. Location of Compartments	

2. Complete Mailing Address

Street Address		Building Name	
Floor(s)	Suite(s)	Room(s) #	
City		Base/Post	
State/Country ST		Zip Code	

4. Responsible Security Personnel

	PRIMARY	ALTERNATE
Name		
Commercial Phone		
DSN Phone		
Secure Phone		
STE Other Phone		
Other Telephone		
Home (optional)		
Facsimile Numbers:	Classified	Unclassified
Command or Regional Special Security Office/Name (SSO) (if applicable)		
Commercial Phone		
Other Phone		
Information System Security Officer Name		
Commercial Telephone		
Secure Telephone		

5. E-Mail Address of Responsible Security Personnel									
Classified					Network/System Name & Level				
Unclassified					Network/System Name				
Other					Network/System Name				
6. Accreditation Data (Ref Chapter: 12E)									
a. Category/Compartments of SCI Requested:									
<u>1) Indicate storage requirement:</u>									
<input type="checkbox"/> Open		<input type="checkbox"/> Closed		<input type="checkbox"/> Continuous Operation			<input type="checkbox"/> None		
<u>2) Indicate the facility type</u>									
<input type="checkbox"/> Permanent		<input type="checkbox"/> Temporary		<input type="checkbox"/> Secure Working Area			<input type="checkbox"/> TSWA		
b. Existing Accreditation Information (if applicable)									
1) SCIF accesses required									
Accreditation granted by:							On:		
3) Waivers:									
<u>3) Co-Use Agreements</u>							<input type="checkbox"/> Yes		<input type="checkbox"/> No
If yes, provide sponsor:									
c. SAP(s) co-located within SCIF							<input type="checkbox"/> Yes		<input type="checkbox"/> No
If yes, identify SAP Classification level (check all that apply)									
<input type="checkbox"/> SCI		<input type="checkbox"/> Top Secret		<input type="checkbox"/> Secret			<input type="checkbox"/> Confidential		
c. SCIF Duty Hours		Hours to Hours:			Days Per Week:				
d. Total square footage that the SCIF occupies:									
e. Has or will CSA requested any waivers?							<input type="checkbox"/> Yes		<input type="checkbox"/> No
							<input type="checkbox"/> N/A		
If yes, attach a copy of approved waiver									
7. Construction/Modification (Ref: Chapter 3B)									
a. Is construction or modification complete?							<input type="checkbox"/> Yes		<input type="checkbox"/> No
							<input type="checkbox"/> N/A		
If no, enter the expected date of completion:									
8. Inspections (Ref: Chapter 12G) (ALL INSPECTION REPORTS MUST BE ATTACHED)									
a. TSCM Service completed by:							On		
Were deficiencies corrected?							<input type="checkbox"/> Yes		<input type="checkbox"/> No
							<input type="checkbox"/> N/A		
If NO, explain:									
b. Last physical security inspection by:							On		
Were deficiencies corrected?							<input type="checkbox"/> Yes		<input type="checkbox"/> No
							<input type="checkbox"/> N/A		

	If NO, explain:		
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 70%; padding: 5px;">c. Last Staff Assistance Visit by:</td> <td style="width: 30%; padding: 5px;">On</td> </tr> </table>	c. Last Staff Assistance Visit by:	On
c. Last Staff Assistance Visit by:	On		

9. REMARKS:	
--------------------	--

Section B: Physical Security

1.Decks, bulkheads and overhead construction

Are the decks, bulkheads and overhead constructed of aluminum plate or standards shipboard material true floor to ceiling?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
--	------------------------------	-----------------------------

2.Security In-Depth

	What external security attributes and/or features should the CSA consider before determining whether or not this facility has Security In-Depth? <i>Please identify/explain all factors:</i>
--	--

3.How is access to the SCIF controlled (Ref: Chapter 8)
--

a. By Guard Force	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, what is their minimum security clearance level?	<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret
b. Is Guard Force Armed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. By assigned personnel?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, do personnel have visual control of SCIF entrance door?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

d. By access control device?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, what kind?		<input type="checkbox"/> Automated access control system	<input type="checkbox"/> Non-Automated	
If Non-Automated				
1. Is there a by-pass key?			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
■ If yes, how is the by-pass key protected?				
2. Manufacturer:		Model:		
(Explain in Remarks if more space is required)				
If Automated				
1. Is there a by-pass key?			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
■ If yes, how is the by-pass key protected?				
2. Manufacturer:		Model:		
(Explain in Remarks if more space is required)				
3. Are access control transmission lines protected by 128-bit encryption/FIBS 140?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If no, explain the physical protection provide				
4. Is automated access control system located within a SCIF or an alarmed area controlled at the SECRET level?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
5. Is the access control system encoded and is ID data and PINs restricted to SCI-indoctrinated personnel?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
6. Does external access control outside SCIF have tamper protection?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
7. Is the access control device integrated with IDS			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
8. Is the access control device integrated with a LAN/WAN System?			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
4. Primary Entrance Door				
a. Is routine ingress and egress to the space through one door?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Is the shipboard type door constructed IAW ICS 705-1,?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Is door constructed of aluminum/steel plate or standard shipboard materials?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Is door equipped with a combination lock that meets requirements of a Pedestrian Deadbolt Federal Specifications FF-L-2890?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
Include lock manufacturer, model and group				
Manufacturer		Model	Group Rating	
e. Is door equipped with an access control device			<input type="checkbox"/> Yes	<input type="checkbox"/> No
f. Is door constructed in a manner which will preclude unauthorized removal of hinge pins and anchor bolts, as well as obstruct access to lock-in bolts between door and frame?			<input type="checkbox"/> Yes	<input type="checkbox"/> No

	g. Remarks:		
5. Emergency Exit			
	a. Is space equipped with an emergency exit?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Has the emergency exit been fabricated of aluminum/steel plate or standard shipboard materials?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Has door(s) been mounted in a frame braced and welded in place in a manner commensurate with structural characteristics of the bulkhead, deck or overhead in which it is located?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. Has the emergency exit been constructed in a manner which will preclude unauthorized removal of hinge pins and anchor bolts, as well as obstructs access to lock-in bolts between door and frame?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	e. Remarks		
6. Restrictions on Damage Control Fittings and Cable			
	a. Are any essential damage control fittings or cables located within or pass through the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Remarks		
7. Removable Hatches and Deck Plates			
	a. Are hatches and deck plates less than 10 square feet that are secured by exposed nuts and bolts (external to SCIF) secured with high security padlocks?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. If key padlocks are used, are the keys stored in a security container located with a space under appropriate security control?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks:		
8. Vent and Duct Barriers			
	a. Are vents, ducts, louvers, or other physical perimeter barrier openings with a cross sectional dimension greater than 96 square inches protected at the perimeter with a fixed barrier or security grill?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. If gratings or bars are used, are they welded in place?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks:		

9. Acoustical Isolation			
	a. Is the physical perimeter of the SCIF sealed or insulated with non-hardening caulking material so as to prevent inadvertent disclosure of SCI discussions or briefings from within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. In instances where the physical perimeter barrier is not sufficient to control voices or sounds, is the use of sound deadening material installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Do air handling units have continuous duty blowers or provide an effective level of sound masking in each air path?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. Remarks:		
10. Visual Isolation			
	a. Are doors or other openings in the physical perimeter barrier through which the interior may be viewed screened or curtailed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Remarks:		
11. Passing Windows and Scuttles			
	a. Have passing windows and scuttles been eliminated from the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Remarks:		
12. Secure Storage Equipment			
	a. Is the SCIF equipped with a sufficient number of GSA approved security containers?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Have they been welded in place or otherwise secured to a foundation for safety?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks:		
Section C: Intrusion Detection Systems (IDS)			
1. Are SCIF access door(s) and emergency exit(s) protected by a visual and audible alarm system:		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	a. Does alarm installation consist of sensors at each door and alerting indicators located within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Does the emergency exit door(s) alarm have a different feature?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Does the system have an alarm monitor station which is continuously manned by personnel capable of responding to or directing a response to an alarm violation of the SCIF when it is unmanned?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. Remarks:		

Section D: Telecommunication Systems and Equipment Baseline				
1. Is the facility declared a "No Classified Discussion Area"? (Ref: Chapter 11A)			<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div style="margin-left: 20px;"> <p>■ If yes, then the audio protection questions within this section may be identified as N/A</p> <p>■ If the facility is declared a "No Classified Discussion Area", are warning notices posted prominently within the facility?</p> </div>				
2. Does the facility have any unclassified telephones that are connected to the commercial public switch telephone network (PSTN)?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
Identify the method of on-hook protection by completing items below				
NOTE: TSG 6 approved phones can be found at the following link: https://www.dni.gov/files/NCSC/documents/products/TSG-Approved-Equipment-List-May-2017.pdf				
a. CNSSI 5006 (TSG-6) approved telephone or instrument			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
<i>(Please identify all telephone equipment/stations and/or instruments being used either below or as an attachment)</i>				
Manufacturer	Model Number	TSG Number (if applicable)		
b. CNSSI 5006 (TSG-6) approved disconnect device?			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
1) Line disconnect?			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
2) Ringer protection?			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
Manufacturer	Model Number	TSG Number (if applicable)		
c. CNSSI 5002 (TSG-2) configured computerized telephone system (CTS)?			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
1) If yes, please provide the following information about the CTS				
Manufacturer		Model Number		
2) If yes, please provide specific location of the CTS				
3) Is the facility protecting the CTS physically controlled?			<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
<div style="margin-left: 20px;"> <p>■ If yes, what is the clearance level (if any) of facility or area where the switch is located.</p> </div>			<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret <input type="checkbox"/> Secret
<div style="margin-left: 20px;"> <p>■ If no facility clearance level how is the facility or area where the switch is located controlled?</p> </div>				
4) How are all cables, signal lines and intermediate writing frames between the SCIF telephones and the CTS physically protected within a physically controlled space?				

5) Are all program media, such as tapes and/or disks, from the CTS afforded physical protection from unauthorized alterations?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
6) Is an up-to-date master copy of the CTS software program maintained for confirmation and/or reloading of the operating system?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
7) Does the CTS have the capability to force or hold a telephone station off-hook?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
8) Does the CTS use remote maintenance and diagnostic procedures or other remote access features?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div style="margin-left: 20px;">■ If yes, explain maintenance procedures</div>			
9) Do the CTS installers and programmers have security clearances?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div style="margin-left: 20px;">■ If yes, at what access level (minimum established by AO)</div>		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret
<div style="margin-left: 20px;">■ If no, are escorts provided?</div>		<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Is it a Voice over Internet Protocol (VOIP) phone system (IPS) (Ref CNSSI 5000)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
1) If yes, please provide the following information about the IPS			
Manufacturer	Model Number	IPS Location	
2) Do all unclassified telephones within the facility have a hold, mute and/or push-to-talk [handset] capability, (for off-hook audio protection)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div style="margin-left: 20px;">■ If no, please explain?</div>			
3) Is access to the facility housing the IPS physically controlled?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div style="margin-left: 20px;">■ If yes, what is the clearance level (if any) of facility or area where the switch is located and how is the area controlled?</div>		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret
<div style="margin-left: 20px;">■ If no facility clearance level how is the facility or area where the IPS is physically located controlled</div>			
4) Are all cables, signal lines and intermediate wiring frames between the SCIF telephones and the IPS physically protected or contained within a physically controlled space?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div style="margin-left: 20px;">■ If no, please explain?</div>			

5) Are all program media, such as tapes and/or disks, from the IPS afforded physical protection from unauthorized alterations?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
6) Is an up-to-date master copy of the IPS software program maintained for confirmation and/or reloading of the operating system?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
7) Does the IPS have the capability to force or hold a telephone station off-hook?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
8) Does the IPS use remote maintenance and diagnostic procedures or other remote access features?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
9) Do the IPS installers and programmers have security clearances?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div style="display: flex; justify-content: space-between;"> <div> <div>■ If yes, at what access level (minimum established by AO)?</div> <div>■ If no, are escorts provided?</div> </div> <div> <div><input type="checkbox"/> SCI</div> <div><input type="checkbox"/> Top Secret</div> <div><input type="checkbox"/> Secret</div> </div> </div>		
3. Automatic telephone call answering		
a. Are there any automatic call answering devices for the telephones in the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
1) If yes, please identify the type		
<div>■ Voicemail/unified message service?</div> <div>■ Standalone telephone answering device (TAD)?</div>	<input type="checkbox"/> Yes <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> No
2) Provide manufacturer and model number of the equipment		
Manufacturer	Model	
b. Are speakerphones/microphones enabled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
<div>■ If yes, has the remote room monitoring capability been disabled?</div> <div>■ Has this been approved for use by the AO?</div>	<input type="checkbox"/> Yes <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> No <input type="checkbox"/> N/A
Provide detailed configuration procedures		
<div>■ If applicable, is the voice mail or unified messaging services configured to prevent unauthorized access from remote diagnostic ports or internal dial tone?</div>	<input type="checkbox"/> Yes	<input type="checkbox"/> No
4. Are any multi-function office machines (M-FOMs) used within the SCIF (M-FOMs are electronic equipment that can be used at network or standalone printers, facsimiles, and copiers)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
a. If yes, please identify the device to include (Please identify all M-FOM devices in use, either below or as an attachment) – Include a manufacture Volatile statement for each M-FOM.		
Make	Model	Serial Number
b. If yes, please identify all features and information processing level of each M-FOM		
1) Copier?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
<div>■ If yes, level(s) of information</div>	<input type="checkbox"/> SCI <input type="checkbox"/> Top Secret <input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified
2) Facsimile?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/A
<div>■ If yes, level(s) of information</div>	<input type="checkbox"/> SCI <input type="checkbox"/> Top Secret <input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified

3) Printer? (connected to a standalone computer or network)				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A																														
<div style="border: 1px solid black; padding: 5px;"> <p>■ If yes, please explain and identify the system(s) and the level(s) of information</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">System:</td> <td style="width: 30%;"></td> <td style="width: 10%;"><input type="checkbox"/> SCI</td> <td style="width: 10%;"><input type="checkbox"/> Top Secret</td> <td style="width: 10%;"><input type="checkbox"/> Secret</td> <td style="width: 10%;"><input type="checkbox"/> Unclassified</td> </tr> <tr> <td>System:</td> <td></td> <td><input type="checkbox"/> SCI</td> <td><input type="checkbox"/> Top Secret</td> <td><input type="checkbox"/> Secret</td> <td><input type="checkbox"/> Unclassified</td> </tr> <tr> <td>System:</td> <td></td> <td><input type="checkbox"/> SCI</td> <td><input type="checkbox"/> Top Secret</td> <td><input type="checkbox"/> Secret</td> <td><input type="checkbox"/> Unclassified</td> </tr> <tr> <td>System:</td> <td></td> <td><input type="checkbox"/> SCI</td> <td><input type="checkbox"/> Top Secret</td> <td><input type="checkbox"/> Secret</td> <td><input type="checkbox"/> Unclassified</td> </tr> <tr> <td>System:</td> <td></td> <td><input type="checkbox"/> SCI</td> <td><input type="checkbox"/> Top Secret</td> <td><input type="checkbox"/> Secret</td> <td><input type="checkbox"/> Unclassified</td> </tr> </table> </div>							System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified	System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified	System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified	System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified	System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified
System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified																															
System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified																															
System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified																															
System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified																															
System:		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified																															
c. Does the M-FOM have memory storage capability?				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A																														
If yes, what kind?	<input type="checkbox"/> Volatile (information in memory clears/erases when powered off)	<input type="checkbox"/> Non-volatile (information in memory that remains when powered off)																																		
d. Does the M-FOM have a digital hard drive?				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A																														
e. Have maintenance and disposition procedures been established?				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A																														
f. Does the M-FOM have voice transmission capability and/or a telephone handset?				<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A																														
<div style="border: 1px solid black; padding: 5px;"> <p>■ If yes, how is this feature protected? Please describe</p> </div>																																				
5. Are there any video teleconference (VTC) systems installed?					<input type="checkbox"/> Yes	<input type="checkbox"/> No																														
<div style="border: 1px solid black; padding: 5px;"> <p>■ If yes, what level(s) of information is the VTC system processing?</p> </div>		<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	<input type="checkbox"/> Unclassified																															
6. Are all telecommunications systems, devices, features, and software documented? (Attached telecommunication baseline)					<input type="checkbox"/> Yes	<input type="checkbox"/> No																														
7. Sound Powered Telephones																																				
Have all sound powered telephones been eliminated from the SCIF?					<input type="checkbox"/> Yes	<input type="checkbox"/> No																														
If no, answer the following questions																																				
a. Are there sound powered or other telephone systems in the facility which cannot connect to locations outside the SCIF?					<input type="checkbox"/> Yes	<input type="checkbox"/> No																														
How Many?																																				
b. Are they installed and protected IAW ICS 705-1, Section E?					<input type="checkbox"/> Yes	<input type="checkbox"/> No																														
Remarks																																				
8. General Announcing System																																				

Do general announcing system loudspeakers have an audio amplifier and are the output signal line installed within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Remarks		

9. SCI Intercommunications Announcing Systems

Do any intercommunication type announcing systems that process SCI pass through areas outside the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, list type, manufacturer and model		
Type	Manufacturer	Model
Remarks		

10. Commercial Interconnection Equipment

Are any commercial intercommunications equipment installed within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Remarks		

11. Pneumatic Tube Systems

a. Are there any pneumatic tube systems installed in the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Are they installed IAWICS 705-1, Section E??	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Remarks		

Section E: Classified Destruction Methods

1. Destruction methods

a. Describe the method and equipment used for destruction of classified/sensitive material (if more than one method or device, use Remarks to describe. (If more than one device, use remarks to list all manufacturer and model)		
Method	Device Manufacturer	Model
b. Is a secondary method of destruction available?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Describe the location of destruction site(s) in relation to the secure facility:		

	d. Describe method or procedure used for handling non-soluble classified/sensitive material at this facility:			
	e. Do you have a written Emergency Action Plan (EAP) approved by CSA (if required)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	Remarks			
Section F: TEMPEST/Technical Security				
	1. Does the facility electronically process classified information?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	If yes, what is the highest level of information processed?	<input type="checkbox"/> SCI <input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret	
2. For the last TEMPEST Accreditation (if applicable), provide the following information				
	Accreditation granted by:	On		
	3. Has the CSA's Certified TEMPEST Technical Authority (CTTA) required any TEMPEST countermeasures?			<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
	If yes, please identify the countermeasures that have been installed (i.e. non-conductive sections, Radio Frequency (RF) shielding, power/signal line filters, window film, etc.)			
	4. Are there any other systems installed within or in close proximity to the SCIF that have RF capability (e.g., fire alarm, ground-to-air-radio, cellular tower, RF networks, etc)?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	If yes, please explain			

SUBMARINE

SCIF Fixed Facility Checklist

Organization Name:

FFC Date:

CLASSIFY ACCORDING TO CLASSIFICATION AUTHORITY

CHECK Applicable blocks		
<input type="checkbox"/> Initial Accreditation	<input type="checkbox"/> Re- Accreditation	<input type="checkbox"/> Modified Submarine
<input type="checkbox"/> Pre-construction	<input type="checkbox"/> New Submarine	<input type="checkbox"/> Page Change

Checklist Contents

Section A: General information

Section B: Physical Security

Section C: Telecommunication Systems and Equipment Baseline

Section D: Classified Destruction Methods

Section E: TEMPEST/Technical Security

List of Attachments

(Diagrams must be submitted)

Section A: General Information

1. SCIF Data

a. Organization/Company Name	
b. Name of Submarine and Hull number	
c. Home Port	
d. SCIF ID Number	
e. Contract Number and Expiration	
f. Date (if applicable)	
g. Concept Approval Date	
h. Cognizant Security Authority (CSA)	
Defense Special Security Communication System Information (if applicable)	
i. DSSCS Message Address	
j. DSSCS INFO Address	
k. If no DSSCS Message Address, please provide passing instructions	
l. GENSER Address	

2. Complete Mailing Address

Street Address		Building Name	
Floor(s)	Suite(s)	Room(s) #	
City		Base/Post	
State/Country		Zip Code	

4. Responsible Security Personnel

	PRIMARY	ALTERNATE
Name		
Rank/Rate/Title		
Commercial Phone		
DSN Phone		
Secure Phone		
STE Other Phone		
Other Telephone		
Home (optional)		
Facsimile Numbers:	Classified	Unclassified
Command or Regional Special Security Office/Name (SSO) (if applicable)		
Commercial Phone		
Other Phone		
Information System Security Officer Name		
Commercial Telephone		
Commercial Telephone		
Secure Telephone		

E-Mail Address of Responsible Security Personnel					
Classified	Network/System Name & Level				
Unclassified	Network/System Name				
Other	Network/System Name				
5. Accreditation Data (Ref Chapter: 12E)					
a. Category/Compartments of SCI Requested:					
1) Indicate storage requirement:					
<input type="checkbox"/> Open	<input type="checkbox"/> Closed	<input type="checkbox"/> Continuous Operation	<input type="checkbox"/> None		
2) Indicate the facility type					
<input type="checkbox"/> Permanent	<input type="checkbox"/> Temporary	<input type="checkbox"/> Secure Working Area	<input type="checkbox"/> TSWA	<input type="checkbox"/> T-SCIF	
b. Existing Accreditation Information (if applicable)					
1) SCIF accesses required					
Accreditation granted by:			On:		
3) Waivers:					
c. SCIF Duty Hours	Hours to Hours:	Days Per Week:			
d. Total square footage that the SCIF occupies:					
e. Last physical security inspection by:			On		
Were deficiencies corrected?			<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
If NO, explain:					
6. Remarks					

Section B: Physical Security

1. Decks, bulkheads and overhead construction

Are the decks, bulkheads and overhead constructed of aluminum plate or standards shipboard material true floor to ceiling?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
--	------------------------------	-----------------------------

2. Security In-Depth

	What external security attributes and/or features should the CSA consider before determining whether or not this facility has Security In-Depth? <i>Please identify/explain all factors:</i>

3. Access Controls: How is access to the SCIF controlled (Ref: Chapter 8)

a. By Guard Force	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, what is their minimum security clearance level?	<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret
b. Is Guard Force Armed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. By assigned personnel?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, do personnel have visual control of SCIF entrance door?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. By access control device?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, what kind?	<input type="checkbox"/> Automated access control system	<input type="checkbox"/> Non-Automated
If non-automated		
1. Is there a by-pass key?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
■ If yes, how is the by-pass key protected?		
2. Manufacturer:	Model:	
<i>(Explain in Remarks if more space is required)</i>		

4. Primary Entrance Door

a. Is routine ingress and egress to the space through one door?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
b. Is the submarine type door constructed IAW ICS 705-1,?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
c. Is door constructed of aluminum/steel plate or standard submarine materials?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
d. Is door equipped with a combination lock that meets requirements of a Pedestrian Deadbolt Federal Specifications FF-L-2890?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Include lock manufacturer, model and group		
Manufacturer	Model	Group Rating
e. Is door equipped with an access control device	<input type="checkbox"/> Yes	<input type="checkbox"/> No
f. Is door constructed in a manner which will preclude unauthorized removal of hinge pins and anchor bolts, as well as obstruct access to lock-in bolts between door and frame?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

	g. Remarks:		
5. Emergency Exit			
	a. Is space equipped with an emergency exit?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Has the emergency exit been fabricated of aluminum/steel plate or standard submarine materials?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Has door(s) been mounted in a frame braced and welded in place in a manner commensurate with structural characteristics of the bulkhead, deck or overhead in which it is located?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	d. Has the emergency exit been constructed in a manner which will preclude unauthorized removal of hinge pins and anchor bolts, as well as obstructs access to lock-in bolts between door and frame?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	e. Remarks		
6. Restrictions on Damage Control Fittings and Cable			
	a. Are any essential damage control fittings or cables located within or pass through the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Remarks		
7. Vent and Duct Barriers			
	a. Are vents, ducts, louvers, or other physical perimeter barrier openings with a cross sectional dimension greater than 96 square inches protected at the perimeter with a fixed barrier or security grill?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. If gratings or bars are used, are they welded in place?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks:		
8. Acoustical Isolation			
	a. Is the physical perimeter of the SCIF sealed or insulated with non-hardening caulking material so as to prevent inadvertent disclosure of SCI discussions or briefings from within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. In instances where the physical perimeter barrier is not sufficient to control voices or sounds, is the use of sound deadening material installed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Do air handling units have continuous duty blowers or provide an effective level of sound masking in each air path?	<input type="checkbox"/> Yes	<input type="checkbox"/> No

	d. Remarks:		
9. Visual Isolation			
	a. Are doors or other openings in the physical perimeter barrier through which the interior may be viewed screened or curtailed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Remarks:		
10. Secure Storage Equipment			
	a. Is the SCIF equipped with a sufficient number of GSA approved security containers?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	b. Have they been welded in place or otherwise secured to a foundation for safety?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	c. Remarks:		
Section C: Telecommunication Systems and Equipment Baseline			
1. Is the Submarine declared a "No Classified Discussion Area"? (Ref: Chapter 11A)		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	<input checked="" type="checkbox"/> If yes, then the audio protection questions within this section may be identified as N/A <input checked="" type="checkbox"/> If the submarine is declared a "No Classified Discussion Area", are warning notices posted prominently within the submarine?		
		<input type="checkbox"/> Yes	<input type="checkbox"/> No
		<input type="checkbox"/> N/A	
2. Does the submarine have any unclassified telephones that are connected to the commercial public switch telephone network (PSTN)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
Identify the method of on-hook protection by completing items below			
NOTE: TSG 6 approved phones can be found at the following link: https://www.dni.gov/files/NCSC/documents/products/TSG-Approved-Equipment-List-May-2017.pdf			
	a. CNSSI 5006 (TSG-6) approved telephone or instrument	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	(Please identify all telephone equipment/stations and/or instruments being used either below or as an attachment)		
	Manufacturer	Model Number	TSG Number (if applicable)
	b. If No, Please explain		
3. Automatic telephone call answering			
	a. Are there any automatic call answering devices for the telephones in the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	1) If yes, please identify the type		
	<input checked="" type="checkbox"/> Voicemail/unified message service?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	<input checked="" type="checkbox"/> Standalone telephone answering device (TAD)?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	2) Provide manufacturer and model number of the equipment		
	Manufacturer	Model	

8.	b. Are speakerphones/microphones enabled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/A
	■ If yes, has the remote room monitoring capability been disabled?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	General Announcing System 1MC/7MC/27MC ETC			
	Do general announcing system loud speakers have an audio amplifier and are the output signal lines installed within the SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Remarks				

Section D: Classified Destruction Methods

1. Destruction methods

	a. Describe the method and equipment used for destruction of classified/sensitive material (if more than one method or device, use Remarks to describe. (If more than one device, use remarks to list all manufacturer and model)			
	Method	Device Manufacturer	Model	
	b. Is a secondary method of destruction available?			<input type="checkbox"/> Yes <input type="checkbox"/> No
	c. Describe the location of destruction site(s) in relation to the secure submarine:			
	d. Describe method or procedure used for handling non-soluble classified/sensitive material on the submarine:			
	e. Do you have a written Emergency Action Plan (EAP) approved by CSA (if required)?			<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
Remarks				

Section E: TEMPEST/Technical Security

1. Does the submarine electronically process classified information?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, what is the highest level of information processed?	<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret		
2. For the last TEMPEST Accreditation (if applicable), provide the following information					
Accreditation granted by:	On				
3. Has the CSA's Certified TEMPEST Technical Authority (CTTA) required any TEMPEST countermeasures?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, please identify the countermeasures that have been installed (i.e. non-conductive sections, Radio Frequency (RF) shielding, power/signal line filters, window film, etc.)					
4. Are there any other systems installed within or in close proximity to the SCIF that have RF capability (e.g., fire alarm, ground-to-air-radio, cellular tower, RF networks, etc)?				<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, please explain					

CLASSIFY ACCORDING TO FACILITY SPONSOR
CLASSIFICATION GUIDANCE

Aircraft/UAV Checklist

[Insert Org Name]

[Date]

[Address]

This page intentionally left blank.

CHECK Applicable blocks		
<input type="checkbox"/> Initial Accreditation	<input type="checkbox"/> Re- Accreditation	<input type="checkbox"/> Modified Facility
<input type="checkbox"/> Pre-construction	<input type="checkbox"/> New Facility	<input type="checkbox"/> Page Change

Checklist Contents

Section A: General information

Section B: Physical Security

Section C: Intrusion Detection Systems (IDS)

Section D: Classified Destruction Methods

Section E: TEMPEST/Technical Security

List of Attachments

(Diagrams must be submitted on 8 ½'' x 11'' or 11'' x 17'' format)

Section A: General Information					
1.	SCIF Data				
	a. Organization/ Company Name				
	b. Type of Aircraft and Tail Number				
	c. Home Station				
	d. SCIF ID Number				
	e. Contract Number and Expiration Date (if applicable)				
	f. Concept Approval Date				
	g. Cognizant Security Authority (CSA)				
	h. Defense Special Security Communication System Information (if applicable)				
	DSSCS Message Address				
	DSSCS INFO Address				
	If no DSSCS Message Address, please provide passing instructions				
2.	Complete Mailing Address				
3.	E-Mail Address				
	Classified		(Network/ System Name & Level)		
	Unclassified		(Network/ System Name)		
	Additional		(Network/ System Name)		
4.	Responsible Security Personnel				
		PRIMARY		ALTERNATE	
	Name				
	Commercial Telephone				
	DSN Telephone				
	Secure Telephone				
	STE Telephone				
	Other Telephone				
	Home Telephone (Optional)				
	FAX #	Classified		Unclassified	

	Command or Regional Special Security Office/Name (SSO): <i>(if applicable)</i>		
	Commercial		
	Other Telephone		
		PRIMARY	ALTERNATE
	Information System Security Officer Name:		
	Commercial		
5.	Secure		
	Accreditation Data		
	a. Category/Compartments of SCI Requested:		
	b. Existing Accreditation Information <i>(if applicable)</i>		
	(1) Category/ Compartments of SCI:		
	(2) Accreditation granted by:		On:
	(3) Co-Use Agreements	<input type="checkbox"/> Yes <input type="checkbox"/> No	If yes, provide sponsor/ compartment:
	c. Is there a SAP(s) co-located within the aircraft?		<input type="checkbox"/> Yes <input type="checkbox"/> No
	SAP Classification Level <i>(check all that apply)</i>		
	<input type="checkbox"/> SCI	<input type="checkbox"/> Top Secret	<input type="checkbox"/> Secret <input type="checkbox"/> Confidential
	d. Has CSA requested any waivers?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/ A	If yes, attach a copy of the approved waiver
6.	Inspections		
	a. Last physical security inspection performed by		On _____ <i>(Attach a copy of report)</i>
	Were deficiencies corrected?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/ A	If no, explain
	REMARKS:		

Section B: Physical Security

1. Stationary Aircraft/UAV

	a. Is the aircraft located within a controlled area?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
	If no, explain:			
	b. When not performing a SCI mission is all SCI removed from the aircraft and stored in an accredited SCIF?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
	If yes, SCIF ID:	If no, explain how SCI is protected when the aircraft is unoccupied:		
2.	Access Control: How is access to the aircraft controlled?			
	a. By Guard Force	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, what is their security clearance level?
	b. Is Guard Force Armed?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	c. By Assigned Personnel:	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	If Yes, do personnel have visual control of the entrance door?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
	d. When processing SCI, are all personnel aboard the aircraft cleared for all the SCI compartments that the aircraft is accredited for?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	If not, what are the procedures for segregating/ protecting SCI compartments from unauthorized disclosure?			
3.	Hatches and Doors Leading Inside the Aircraft:			
	a. Are doors equipped with GSA approved locks?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	Manufacturer	Model	Group	
	b. Are tamper serialized seals used when aircraft is unoccupied?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	If yes, are seals installed and a log book maintained by SCI cleared personnel?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	c. Remarks			
4.	Acoustical Isolation			
	a. Is a physical perimeter established around the aircraft at a distance so as to prevent inadvertent disclosure of SCI discussions or briefings from within the aircraft	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	b. In instances where the physical perimeter barrier is not sufficient to control voices or sounds, are sound countermeasure devices or sound generating devices used?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
	c. Remarks			

5.	Visual Isolation		
	a. Are doors or other openings in the aircraft through which the interior may be viewed screened or curtained?	<input type="checkbox"/> Yes	<input type="checkbox"/> Yes
	b. Remarks		
6.	Procedures For Protecting SCI When The Aircraft Is Parked In Friendly/Unfriendly Territories		

Section C: Intrusion Detection Systems (IDS)				
1.	Is the aircraft equipped or located within a structure or area that has an IDS?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please provide the following:			
	a. IDS Company provider name <i>(if applicable)</i>			
	b. Premise Control Unit (PCU)			
	Manufacturer	Model Number	Tamper Protection	<input type="checkbox"/> Yes <input type="checkbox"/> No
	c. Where is the PCU located?			
	d. Location of interior motion detection protection: Accessible points of entry/ perimeter?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	e. Has the IDS Alarm Monitor Station been installed to Underwriters Laboratories certified standards?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please provide certification number and expiration date of UL certification			
	Certification Number		Expiration Date	
	f. Has the IDS passed CSA or UL 2050 installation and acceptance tests?		<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, please attach a copy of certificate and skip to question 2 below. (Non -commercial proprietary system must answer all questions)			
	g. Motion Sensors (Indicate sensor placement on a legible floor plan; 8.5'' x 11'' or 11'' x 17'' paper)			
Manufacturer	Model Number	Tamper Protection	<input type="checkbox"/> Yes <input type="checkbox"/> No	
h. Are motion sensors installed above the false ceiling?		<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/ A	

i. Are motion sensors installed below the false floors?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
j. Are there any other intrusion detection equipment sensors/ detectors in use?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, please identify make, model, and manufacturer and function (indicate on floor plan)			
Make	Model	Manufacturer	Function
k. Does the IDS extend beyond the SCIF perimeter?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Can the status of PCU be changed from outside IDS protection?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, is an audit conducted daily?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
Has the IDS configuration been approved by the CSA?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
l. Do any intrusion detection equipment components have audio or video capabilities?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, please explain:			
Has the CSA mitigated this capability?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
m. IDS Administrator SCI indoctrinated?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
n. External Transmission Line Security: What is the method of line security? Meets NIST; FIPS AES Encryption?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, has the encryption been certified by National Institute of Standards and Technology (NIST) or another independent testing laboratory?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If not NIST FIPS AES, is there an alternate?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, please explain:			
Does the alternate line utilize any cellular or other Radio Frequency (RF) capability?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
If yes, provide manufacturer and model			
Manufacturer	Model		
o. Does any part of the IDS use a local or Wide Area Network?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
(1) Is the Network Intrusion Detection Software (NIDS) administrator at least Top Secret (collateral) cleared?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
(2) Is the host computer dedicated solely for security purposes?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
(3) Is the host computer secured within an alarmed area controlled at the Secret or higher level?	<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A

(4) Is the host computer protected through firewalls or similar devices?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
Are the firewalls/ devices configured to only allow data transfers between IDS components?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
(5) Is the password for the host computer unique for each user and at least 8 characters long?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
(6) Is the password changed semi-annually?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
(7) Are remote security terminals protected the same of the host computer?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
If no, please explain:				
p. Was the IDS installed by U.S. citizens:		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
If no, please explain:				
q. Is emergency power available for the IDS?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
What type? Generator	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, how many hours? _____	
What type? Battery	<input type="checkbox"/> Yes	<input type="checkbox"/> No	If yes, how many hours? _____	
r. If applicable, describe the method of ventilation and duct work protection:				
s. Where is the IDS Alarm Monitor Station located?				
t. Does the Monitor Station have any remote capabilities (i.e., resetting alarms, issuing PINs, accessing/ securing alarms, etc.)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
If yes, please explain:				
u. Does the IDS have any automatic features (i.e., timed auto-secure, auto-access capabilities)?		<input type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> N/ A
v. Does the PCU/ keypad have dial out capabilities?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
w. IDS Response Personnel				
(1) Who provides initial alarm response?				
(2) Does the response force have a security clearance?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
If yes, what is the clearance level:				
(3) Do you have a written agreement for external response force?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
(4) Emergency procedures documented?			<input type="checkbox"/> Yes	<input type="checkbox"/> No
(5) Reserve security force available?			<input type="checkbox"/> Yes	<input type="checkbox"/> No

(6) Response to an alarm condition	_____minutes	
x. Are response procedures tested and records maintained?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
If no, please explain:		
y. If required, has a Catastrophic Failure Plan been approved by the CSA?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
z. Does the IDS undergo semiannual testing?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
aa. Have IDS records been maintained:	<input type="checkbox"/> Yes	<input type="checkbox"/> No
bb. Remarks		

Section D: Classified Destruction Methods			
1.	For home station, describe the method and equipment used for destruction of classified/ sensitive material (if more than one method or device, use Remarks section to describe (if more than one, use Remarks section to list all manufacturer and model)		
	Method	Device Manufacturer	Model
2.	Is a secondary method of destruction available	<input type="checkbox"/> Yes	<input type="checkbox"/> No
3.	Describe the location of destruction site(s) in relation to the aircraft?		
4.	Describe the method or procedure used for handling non -soluble classified/ sensitive material at your facility?		
5.	Do you have a written Emergency Action Plan (EAP) approved by CSA?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
6.	Describe procedures for in-flight emergency destruction:		
7.	Remarks		
Section E: TEMPEST/Technical Security			
1.	Does the aircraft electronically process classified information?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
	If yes, what is the highest level of information processed?		
2.	Has it received TEMPEST accreditation?	<input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> N/ A
	Date	Accreditation granted by:	

CLASSIFICATION

SCIF CO-UTILIZATION or JOINT-UTILIZATION Request**1. To: Host Government CSA:****2. From: Tenant Government CSA:**

Date:

Tenant POC:
Name/Title/Telephone
and Email:

Tenant POC:
Name/Title/Telephone
and Email:

3. Facility Location where CUA Desired:

Company/Department Name:
Complete SCIF Address:

SCIF ID:

Room
Numbers:

Host Site Security POC:
Name/Title/Telephone
Email Address

4. Does Facility have Waivers? ☐ No ☐ Yes (If yes, list waivers in item 9)**5. Classification:** (Provide classification level, SCI compartments, and storage requirements for Co-Use)

Highest Classification: ☐ Confidential ☐ Secret ☐ Top Secret

SCI Compartments:

Storage Requirements: ☐ Open ☐ Closed

6. Information Systems POC:

(Provide POC for IS coordination if Co-Utilization or Joint-Utilization)

Tenant IS POC:
Name/Email/Telephone:

☐ **Co-Utilization:**

- ☐ Use a system that will not be connected to system(s) for which the agency with cognizance for the SCIF is the accreditor or,
- ☐ Use for period processing only an existing system for which the agency with cognizance for the SCIF is the accreditor
- ☐ Information System Processing Not required storage and /or discussion only

Classified By:

Derived From:

Declassify on:

This form is UNCLASSIFIED until filled in

CLASSIFICATION

01 14 00AT1
CUI

CLASSIFICATION

☐ **Joint-utilization:**

- ☐ Use an existing system for which the agency with cognizance for the SCIF is the accreditor
- ☐ Such use will consist of: Logical separation of data (via software) or
- ☐ Co-mingle data, no separation. (Detailed justification required in item 9.)

7. Duration:

A. Contractor Facility:

RFP Date: (if applicable):

Expiration Date of Contract:

Contract Number:

B. Government Facility:

Expiration Date: (enter date or "Indefinite")

8. Type of Effort:☐

Intel Related

☐

Other (describe)

9. Comments/Justification/MOA:**TENANT; CUA
Coordinator:**

Digital Signature

**HOST; CUA
Coordinator:**

Digital Signature

This form is UNCLASSIFIED until filled in

CLASSIFICATION

Select/Type Appropriate Classification

SCIF CO-UTILIZATION or JOINT-UTILIZATION Request**1. To: Host Government CSA:**

Host IC Agency SCIF Owner

2. From: Tenant Government CSA:

Tenant/Requesting IC Agency

Date:

Current Date

Tenant POC:
Name/Title/Telephone
and Email:

CUA/JUA Tenant Agency POC Located on site

Tenant POC:
Name/Title/Telephone
and Email:

CUA/JUA Tenant Agency POC Located on site

3. Facility Location where CUA Desired :

Complete Address of SCIF where CUA is located

Company/Department Name:
Complete SCIF Address:

SCIF ID:

SCIF ID as assigned by Host Government CSA

Room
Numbers:

List all Rooms associated with the CUA/JUA

Host Site Security POC:
Name/Title/Telephone
Email Address

CSSO/SSO/ASO of SCIF Name and Title

Email and Phone of CSSO/SSO/ASO

4. Does Facility have Waivers?☐ No☐ Yes (If yes, list waivers in item 9)**Select One****5. Classification:** (Provide classification level, SCI compartments, and storage requirements for Co-Use)

Highest Classification:

☐ Confidential☐ Secret☐ Top Secret**Select One**

SCI Compartments:

List SCI Compartments that the CUA/JUA operate at

Storage Requirements:

☐ Open☐ Closed**Select One****6. Information Systems POC:**

(Provide POC for IS coordination if Co-Utilization or Joint-Utilization)

Tenant IS POC:

Name/Email/Telephone:

Tenant IS POC, Name Email and Phone

☐ **Co-Utilization:** Select all that apply☐ Use a system that will not be connected to system(s) for which the agency with cognizance for the SCIF is the accreditor or,☐ use for period processing only an existing system for which the agency with cognizance for the SCIF is the accreditor☐ Information System Processing Not Required storage and /or discussion only

Classified By:

Who is completing form Employee ID or Name

Derived From:

Security Classification Guide used

Declassify on:

Declassification date from SCG

This form is UNCLASSIFIED until filled in

CLASSIFICATION

Select/Type Appropriate Classification

This form is UNCLASSIFIED until filled in

CLASSIFICATION

Select/Type Appropriate Classification☐ **Joint-utilization:** **Select all that apply**

- ☐ Use an existing system for which the agency with cognizance for the SCIF is the accreditor
- ☐ Such use will consist of: Logical separation of data (via software) or
- ☐ co-mingle data, no separation. (Detailed justification required in item 9.)

7. Duration:

A. Contractor Facility:

RFP Date: (if applicable): **DD Month YYYY**Expiration Date of Contract: **DD Month YYYY**Contract Number: **DD-254 Contract Number Supporting CUA/JUA**

B. Government Facility:

Expiration Date: (enter date or "Indefinite") **DD Month YYYY****Check Host Agency Requirements****8. Type of Effort:** ☐ Intel Related ☐ Other (describe) **Select one****Explain if different from above****9. Comments/Justification/MOA:****Justification for CUA/JUA be specific and as detailed as possible****TENANT; CUA
Coordinator:****Tenant Agency CUA Coordinator Name****DD MM YYYY**

Digital Signature

Digital Signature of CUA Coordinator**HOST; CUA
Coordinator:****Host Agency CUA coordinator Name****DD MM YYYY**

Digital Signature

Digital Signature of CUA Coordinator*This form is UNCLASSIFIED until filled in*

CLASSIFICATION

Select/Type Appropriate Classification

CUWG: Co-Utilization/Joint Utilization form Version 5

CLASSIFICATION

Cancellation of SCIF Co-Utilization or Joint-Utilization**1. To: Host Government CSA:****2. From: Tenant Government CSA:**

Date:

Tenant POC:
Name/Title/Telephone
and Email:**3. Facility Location of CUA/JUA:****4. SCIF ID:****5. Room Numbers:****6. Comments:****Tenant; CUA
Coordinator:**

Digital Signature

Classified By:

Derived From:

Declassify on:

This form is UNCLASSIFIED until filled in

CLASSIFICATION

01 14 00AT1
CUI

SCIF Pre-Construction Checklist

This checklist is intended to provide the CSA/AO with the information required to determine the minimum security requirements for final SCIF accreditation and to assist the project personnel with planning and designing the SCIF appropriately and cost efficiently. When completing this checklist, provide as much detail as possible based upon what is known at the time it is being filled out. If any information is not known, mark the question/section as unknown and provide a description in section 5 or on additional pages that are attached to the checklist when it is sent to the AO.

Notes:

1. This checklist is not intended to contain any classified information. Completing the checklist should not make it classified, however, consult with your AO or security office before sending a completed checklist across unclassified lines of communication.
2. The digital/soft copy of this checklist has a 'mouse over' feature where the user can place the mouse over a section and additional information will appear to assist in filling out the checklist.

Checklist Contents

Section 1: GENERAL

Section 2: CONSTRUCTION

Section 3: PERSONNEL SITE SECURITY

Section 4: PHYSICAL SITE SECURITY

Section 5: ADDITIONAL COMMENTS

SCIF Pre-Construction Checklist

1. GENERAL	
1.1 Organization/SCIF Owner Name	
1.2 Date Checklist Submitted	
1.3 SCIF Identification Number (if applicable)	
1.4 Organization Subordinate to (if applicable)	
1.5 Construction Project Name/Title	
1.6 Construction Project Address Notes: 1. If classified, write N/A.	
1.7 Name(s), Position Title(s), and Contact Information of Individual(s) Completing this Checklist.	Name(s): Position Title(s): Email Address(s): Phone Number(s):
1.8 Expected Start Date of Construction	
1.9 Expected End Date of Construction	
1.10 Who is currently the primary security point of contact for the construction project (i.e. who will the AO interface with directly throughout planning and design). This is typically the SSM, however, if an SSM has not yet been identified there needs to be a primary security POC until an SSM is assigned. Notes: 1. If this person changes the AO must be notified.	Name: Position Title: Organization: Email Address: Phone Number: Comments:

SCIF Pre-Construction Checklist

<p>1.11 Will the person identified in number 1.10 attend all: Design Reviews, Construction Project Planning Meetings, and Other Project Related Meetings prior to the release of the construction contract bid package?</p> <p>Notes:</p> <p>1. A security representative shall be included throughout the construction project planning process to ensure all construction accreditation requirements (STC, ATFP, TEMPEST, etc.) are included in the construction project requirements.</p>	<input type="radio"/> Same Person	<input type="radio"/> Different Person
<p>1.11.1 If a Different Person than identified in question 1.10, identify who will represent the security requirements during these meetings. Include Name, Position, Organization, and contact information.</p>	<p>Name:</p> <p>Position Title:</p> <p>Organization:</p> <p>Email Address:</p> <p>Phone Number:</p> <p>Comments:</p>	
<p>1.12 Security In-Depth Starting Point (Mandatory Outside the US) – Will the construction project be located (check all that apply):</p>	<p><input type="radio"/> On a military installation, embassy compound, USG compound or contractor compound with a dedicated U.S. person response force.</p> <p><input type="radio"/> Within a controlled building with separate access controls, alarms, elevator controls, stairwell control, etc. required to gain access to building or elevator.</p> <p><input type="radio"/> Controlled office areas adjacent to or surrounding SCIFs that are protected by alarm equipment installed in accordance with manufacturer's instructions.</p> <p><input type="radio"/> Fenced compounds with access-controlled vehicle gate and/or pedestrian gate.</p> <p><input type="radio"/> None of the above (only optional within the US)</p> <p>Comments:</p>	

SCIF Pre-Construction Checklist

<p>2.2.2 Describe what is being modified in the building. Is it being removed? Added? Both? Use additional pages if necessary.</p>	<p>Description:</p>		
<p>2.3 At the end of construction, will the SCIF be the entire building or will the SCIF be an area within a larger building?</p>	<input type="radio"/> The entire building will be a SCIF	<input type="radio"/> The SCIF will be an area within a larger building	
<p>2.3.1 If the SCIF is an area within a larger building, what are the classification levels of the rest of the building? Check all that apply.</p>	<input type="radio"/> SCI <input type="radio"/> TS <input type="radio"/> Secret <input type="radio"/> Confidential <input type="radio"/> Unclassified		
<p>2.3.2 If the SCIF is an area within a larger building, will foreign nationals occupy any area of the building? If the answer is no, skip to 2.4. Notes: 1. Foreign Nationals include anyone that is not a US citizen (to include US persons).</p>	<input type="radio"/> Yes, foreign nationals will work in this building.	<input type="radio"/> No, foreign nationals will not work in this building.	<input type="radio"/> Unknown – Provide description of why it is unknown in section 5 of this document.

SCIF Pre-Construction Checklist

2.3.2.1 If yes to 2.3.2, describe the nationalities of all foreign nationalities expected to work in the building, if known. Use additional pages if necessary.	Description:		
2.3.2.2 If yes to 2.3.2, can a foreign national access any area(s) immediately adjacent to the SCIF (i.e. can a foreign national touch the SCIF perimeter)? This includes all SCIF walls, floors, and ceilings. If yes, please describe. Use additional pages if necessary.	Description:		
2.3.2.3 If yes to 2.3.2, does the US government or SCIF owner (i.e. US Contractor) have control over the entire building, to include space occupied by foreign nationals?	<input type="radio"/> Yes, the US government/SCIF owner has control over the building and all space within.	<input type="radio"/> No, the US government/SCIF owner does not have control over the building and all space within.	
2.4 What is the square footage of the SCIF?	Description:		
2.5 Will the SCIF have Compartmented Areas (CA)? If no, skip to 2.6.	<input type="radio"/> Yes, the SCIF will have CA.	<input type="radio"/> No, the SCIF will not have CA.	
2.5.1 If yes to 2.5, has the CA Checklist (Chapter 13 of the ICD/ICS Tech. Spec.) been completed? If yes, attach a copy to this checklist when sending to the AO. If no, complete 2.5.1.1.	<input type="radio"/> Yes	<input type="radio"/> No	
2.5.1.1 If no to 2.5.1, when will the CA checklist(s) be completed for submission to the AO?	Date:		
2.6 Will the SCIF contain equipment that will be processing National Security Information (NSI)?	<input type="radio"/> Yes	<input type="radio"/> No	

SCIF Pre-Construction Checklist

2.7 Has the supported command/SCIF owner provided the CTTA, through the AO, with a completed TEMPEST Checklist (Chapter 13 of the ICD/ICS Tech. Spec.) for review? If yes, complete 2.7.1 If no, complete 2.7.2.	<input type="radio"/> Yes	<input type="radio"/> No
2.7.1 If yes to 2.7, will there be a TEMPEST requirement?	<input type="radio"/> Yes	<input type="radio"/> No
2.7.2 If no to 2.7, when will the TEMPEST Checklist be completed for submission to the AO? Notes: 1. Based on CTTA recommendations, the AO may require TEMPEST countermeasures for any SCIF.	Date:	
2.8 Construction General Contractor (GC) – Will the GC be US owned, Non-US owned (Foreign), or multiple/both?	<input type="radio"/> US Owned <input type="radio"/> Non-US Owned (Foreign) (must have AO approval) Complete 2.8.1 <input type="radio"/> Multiple/Both (if planning to use a different GC for different phases of construction). Complete 2.8.1 <input type="radio"/> Unknown Complete 2.8.1	
2.8.1 Describe the situation for why the GC will not be US owned and/or why it is unknown what the GC will be. Notes: 1. The AO must approve the GC being Non-US owned. Use additional pages if necessary.	Description:	

SCIF Pre-Construction Checklist

<p>2.9 Construction Subcontractors – Will the construction subcontractor(s) be US owned, Non-US owned (Foreign), or multiple/both?</p>	<p><input type="radio"/> US Owned</p> <p><input type="radio"/> Non-US Owned (Foreign) (must have AO approval) Complete 2.9.1</p> <p><input type="radio"/> Multiple/Both (if planning to use a different GC for different phases of construction). Complete 2.9.1</p> <p><input type="radio"/> Unknown Complete 2.9.1</p>
<p>2.9.1 Describe the situation for why the subcontractor(s) will not be US owned and/or why it is unknown what the subcontractor(s) will be. Notes:</p> <p>1. The AO must approve subcontractors being Non-US owned. Use additional pages if necessary.</p>	<p>Description:</p>
<p>2.10 Construction Labor (who will do the construction work) – Will the construction labor be Uncleared or Cleared? Identify specifically the categories of construction labor. Check all that apply. If using multiple categories and/or if additional information is available, complete 2.10.1.</p>	<p><input type="radio"/> Uncleared (no US security clearance)</p> <ul style="list-style-type: none"> <input type="radio"/> US Citizens <input type="radio"/> US Persons <input type="radio"/> Non-US citizens/persons (must have AO approval) <ul style="list-style-type: none"> <input type="radio"/> Local (Host) Nationals (LN) <input type="radio"/> Third Country Nationals (TCN) <p><input type="radio"/> Cleared American Worker (has US issued security clearance)</p> <ul style="list-style-type: none"> <input type="radio"/> Secret Cleared <input type="radio"/> Top Secret Cleared <input type="radio"/> Top Secret/SCI Cleared <p><input type="radio"/> Unknown – Provide description of why it is unknown in section 5 of this document.</p>
<p>2.10.1 Describe the expectations of the construction labor. Notes:</p> <p>1. The AO must approve non-US citizens and/or non-US persons being used. Use additional pages if necessary.</p>	<p>Description:</p>

SCIF Pre-Construction Checklist

<p>2.11 Are there special requirements for procurement, shipping, and storing of SCIF construction materials? If yes, complete 2.11.1, 2.11.2, and 2.11.3. Notes:</p> <p>1. Projects Outside of the US must mark yes.</p>	<input type="radio"/> Yes	<input type="radio"/> No
<p>2.11.1 Describe the requirements for Material Procurement. Use additional pages if necessary.</p>	<p>Description:</p>	
<p>2.11.2 Describe the requirements for Material Shipping. Use additional pages if necessary.</p>	<p>Description:</p>	

SCIF Pre-Construction Checklist

<p>2.11.3 Describe the requirements for Material Storage. Use additional pages if necessary.</p>	<p>Description:</p>
<p>2.12 What are the expected hours of operation for the construction site (the hours the construction site will be open for construction work to progress)?</p>	<p> <input type="radio"/> 24 hours a day <input type="radio"/> Less than 24 hours a day List the hours of operation here _____ <input type="radio"/> Unknown When will the hours be identified? </p>
<p>2.13 What are the days of the week the construction site will be open (the days the construction site will be open for construction work to progress)?</p>	<p> <input type="radio"/> 7 days a week <input type="radio"/> Less than days a week List the days of operation here _____ <input type="radio"/> Unknown When will the days be identified? </p>

SCIF Pre-Construction Checklist

3. PERSONNEL SITE SECURITY		
3.1 Has a Site Security Manager (SSM) been identified? If yes, complete 3.1.1. If no, complete 3.1.2	<input type="radio"/> Yes	<input type="radio"/> No
3.1.1 If yes to 3.1, identify the SSM and provide contact information.	Name: _____ Organization/Company: _____ Email Address: _____ Phone Number: _____	
3.1.2 If no to 3.1, identify the source that will provide the SSM. Notes: 1. To avoid potential conflicts of interest, the SSM shall not be contracted under the Construction General Contractor (GC).	<input type="radio"/> US Government Supplying Organization _____ <input type="radio"/> US Military Supplying Organization _____ <input type="radio"/> US Contractor Expected Contract Start Date _____	
3.2 Will Construction Surveillance Technicians (CST) be used? If yes, complete 3.2.1 and 3.2.2. Notes: 1. Outside of the US – The use of CSTs is required. 2. Within the US – The use of CSTs is required when directed by the AO only.	<input type="radio"/> Yes	<input type="radio"/> No
3.2.1 If yes to 3.2, identify the source that will provide the CSTs. Notes: 1. To avoid potential conflicts of interest, CSTs shall not be contracted under the Construction General Contractor (GC).	<input type="radio"/> US Government Supplying Organization _____ <input type="radio"/> US Military Supplying Organization _____ <input type="radio"/> US Contractor Expected Contract Start Date _____	
3.2.2 If yes to 3.2, what is the approximated number of CSTs needed at peak requirements and what is the minimum clearance requirement for the CSTs?	Approximated number of CSTs: _____ Clearance requirement for CSTs: _____	

SCIF Pre-Construction Checklist

3.3 Will Cleared American Guards (CAG) be used? If yes, complete 3.3.1 and 3.3.2.	<input type="radio"/> Yes	<input type="radio"/> No
3.3.1 If yes to 3.3, identify the source that will provide the CAGs. Notes: 1. To avoid potential conflicts of interest, the CAGs shall not be contracted under the Construction General Contractor (GC).	<input type="radio"/> US Government Supplying Organization _____ <input type="radio"/> US Military Supplying Organization _____ <input type="radio"/> US Contractor Expected Contract Start Date _____	
3.3.2 If yes to 3.3, what is the approximated number of CAGs needed at peak requirements and what is the minimum clearance requirement for the CAGs?	Approximated number of CAGs: _____ Clearance requirement for CAGs: _____	
3.4 Outside of the US – Will non-cleared US guards or non-US guards be used? If yes, complete 3.4.1. Notes: 1. The use of non-cleared US guards or non-US guards must be approved by the AO and these guards must be supervised by a CAG or secret-cleared US citizen.	<input type="radio"/> Yes	<input type="radio"/> No
3.4.1 If yes to 3.4, describe the expected use of non-cleared US guards or non-US guards. Use additional pages if necessary.	Description:	
3.5 Will Cleared Escorts (CE) be used? If yes, complete 3.5.1 and 3.5.2. Notes: 1. A CE is not a CST and shall not replace a CST without proper training/certification, knowledge, and experience required to be a CST.	<input type="radio"/> Yes	<input type="radio"/> No

SCIF Pre-Construction Checklist

<p>3.5.1 If yes to 3.5, identify the source that will provide the CEs.</p>	<p><input type="radio"/> US Government Supplying Organization _____</p> <p><input type="radio"/> US Military Supplying Organization _____</p> <p><input type="radio"/> US Contractor Expected Contract Start Date _____</p>		
<p>3.5.2 If yes to 3.5, what is the approximated number of CEs needed at peak requirements and what is the minimum clearance requirement for the CEs?</p>	<p>Approximated number of CEs: _____</p> <p>Clearance requirement for CEs: _____</p>		
<p>3.6 Has a cost estimate been completed for Personnel Security (SSM, CSTs, CAGs, and/or CEs) requirements? If no, complete 3.6.1. Notes:</p> <p>1. N/A is intended for industry/commercial SCIF owners who may not need to complete a cost estimate.</p>	<p><input type="radio"/> Yes</p>	<p><input type="radio"/> No</p>	<p><input type="radio"/> N/A – Provide description of why it is unknown in section 5 of this document.</p>
<p>3.6.1 If no to 3.6, when will the cost estimate be completed?</p>	<p>Date: _____</p>		
<p>3.7 Has a funding source been identified for Personnel Security requirements? If no, complete 3.7.1. Notes:</p> <p>1. N/A is intended for industry/commercial SCIF owners who may not need to identify a funding source.</p>	<p><input type="radio"/> Yes</p>	<p><input type="radio"/> No</p>	<p><input type="radio"/> N/A – Provide description of why it is unknown in section 5 of this document.</p>
<p>3.7.1 If no to 3.7, when will the personnel security funding source be identified?</p>	<p>Date: _____</p>		

SCIF Pre-Construction Checklist

4. PHYSICAL SITE SECURITY		
4.1 Will the construction project have a perimeter fence? If yes, complete 4.1.1.	<input type="radio"/> Yes	<input type="radio"/> No
4.1.1 If yes to 4.1, describe the fence type. Permanent, temporary, federally rated, etc. Use additional pages if necessary.	Description:	
4.2 Will the construction project have a Secure Storage Area (SSA)? If yes, complete 4.2.1, 4.2.2, and 4.2.3. Notes: 1. Projects Outside of the US must mark yes.	<input type="radio"/> Yes	<input type="radio"/> No
4.2.1 If yes to 4.2, describe the SSA, to include type of area/facility/container and location. Use additional pages if necessary.	Description:	
4.2.2 If yes to 4.2, describe how the SSA will be secured during hours of non-operation. 24/7 CAGs, IDS, CCTV, locks, fence, etc. Use additional pages if necessary.	Description:	

SCIF Pre-Construction Checklist

<p>4.2.3 If yes to 4.2, will the SSA serve additional uses, i.e. material inspections, and if so, please describe the secondary uses. Use additional pages if necessary.</p>	<p>Description:</p>		
<p>4.3 Will the project have an Access Control Facility (ACF)? i.e. Temporarily installed modular facility. If yes, complete 4.3.1 and 4.3.2.</p>	<p><input type="radio"/> Yes</p>	<p><input type="radio"/> No</p>	
<p>4.3.1 If yes to 4.3, Describe the expected square footage of the ACF and what rooms/offices are required for operations. i.e. inspection area, SSM office, conference room, CST break room, etc.</p>	<p>Description:</p>		
<p>4.3.2 If yes to 4.3, describe how the ACF will be secured during hours of non-operation. 24/7 CAGs, IDS, CCTV, locks, fence, etc. Use additional pages if necessary.</p>	<p>Description:</p>		

SCIF Pre-Construction Checklist

<p>4.4 Will any of the listed equipment will be used by the SSM Staff to perform their duties? Check all that apply. Notes:</p> <p>1. If unknown, the AO will confirm required equipment for the SSM Staff to perform their duties.</p>	<div style="margin-bottom: 10px;"><input type="radio"/> X-Ray Machine</div> <div style="margin-left: 20px;"><input type="radio"/> Pallet size, typical in SSA</div> <div style="margin-left: 20px;"><input type="radio"/> Parcel/Airport size, typical in ACF</div> <div style="margin-bottom: 10px;"><input type="radio"/> Hand Held Metal Detectors</div> <div style="margin-bottom: 10px;"><input type="radio"/> Walk Through Metal Detector</div> <div style="margin-bottom: 10px;"><input type="radio"/> Itemizer</div> <div style="margin-bottom: 10px;"><input type="radio"/> Digital Documentation Devices</div> <div style="margin-bottom: 10px;"><input type="radio"/> Computer(s)</div> <div style="margin-bottom: 10px;"><input type="radio"/> Camera(s)</div> <div style="margin-bottom: 10px;"><input type="radio"/> Other (anything else not covered above)</div>
<p>4.4.1 Provide any additional information available regarding SSM Staff equipment.</p>	<p>Description:</p>
<p>4.5 Will the construction project have Intrusion Detection System (IDS)? If yes, complete 4.5.1.</p>	<div style="display: flex; justify-content: space-between;"> <div><input type="radio"/> Yes</div> <div><input type="radio"/> No</div> </div>
<p>4.5.1 If yes to 4.5, describe the construction project IDS and its functions on the project. -Where will the IDS be installed (ACF / SSA / etc.)? -Who will monitor the IDS during construction hours of non-operation? - Who will respond to alarms during construction hours of non-operation? -Who will install the IDS? i.e. US government, security contractor, GC, etc. Use additional pages if necessary.</p>	<p>Description:</p>

SCIF Pre-Construction Checklist

4.6 Will the construction project have Closed Circuit Television (CCTV)? If yes, complete 4.6.1.	<input type="radio"/> Yes	<input type="radio"/> No
4.6.1 Describe the construction project CCTV and its functions on the project. -Where will the video feed go? -Who will monitor the CCTV during construction hours of operation and non-operation? -Who will install the CCTV? i.e. US government, security contractor, GC, etc. Use additional pages if necessary.	Description:	
4.7 Will the construction project have Biometric Identify Verification? If yes, complete 4.7.1.	<input type="radio"/> Yes	<input type="radio"/> No
4.7.1 If yes to 4.7, describe the construction project biometric verification system and its functions on the construction project. -What system will be used? i.e. IRIS or fingerprint. -Who will install the IDS? i.e. US government, security contractor, GC, etc. Use additional pages if necessary.	Description:	
4.8 Will the construction project have additional physical security components not already discussed? If yes, complete 4.8.1.	<input type="radio"/> Yes	<input type="radio"/> No
4.8.1 If yes to 4.8, describe the additional physical security components and how they will be used to protect the construction project. Use additional pages if necessary.	Description:	

SCIF Pre-Construction Checklist

4.9 Has a cost estimate been completed for Physical Security requirements? If no, complete 4.9.1. Notes: 1. N/A is intended for industry/commercial SCIF owners who may not need to complete a cost estimate.	<input type="radio"/> Yes	<input type="radio"/> No	<input type="radio"/> N/A – Provide description of why it is unknown in section 5 of this document.
4.9.1 If no to 4.9, when will the cost estimate be completed?	Date:		
4.10 Has a funding source been identified for Physical Security requirements? If no, complete 4.10.1. Notes: 1. N/A is intended for industry/commercial SCIF owners who may not need to identify a funding source.	<input type="radio"/> Yes	<input type="radio"/> No	<input type="radio"/> N/A – Provide description of why it is unknown in section 5 of this document.
4.10.1 If no to 4.10, when will the physical security funding source be identified?	Date:		

SCIF Pre-Construction Checklist

5. ADDITIONAL COMMENTS

Provide additional comments and information about anything discussed in this checklist and/or other areas of information that the AO should be aware of. Use additional pages if necessary.

Section 5, Additional Comments, page 1 of ____.

SCIF Pre-Construction Checklist

Section 5, Additional Comments, page ____ of ____.
(If additional pages are necessary, print this page multiple times and number them individually)

Construction Security Plan (CSP)

Definition: A plan outlining security protective measures that will be applied to each phase of the construction project. The requirements set forth in this plan provide the baseline for construction security activities and may be supplemented as required but may not be reduced without coordination and approval from the Accrediting Official (AO).

The contents below are suggested topics. The plan format and content shall be developed by the element accrediting official (AO) based upon the size, purpose and location of the SCIF.

-
- a. **Site Security Manager:** (identify the SSM and contact information)
 - b. **Statement of Construction Project:** (provide a description of the proposed work)
 - c. **Existing SCIF ID** (if project is associated with currently accredited SCIF)
 - d. **Cognizant Security Authority/ Accrediting Official:** (element)
 - e. **Location of Work:** (address/ location)
 - f. **Estimated Start Date:** (estimated date construction will begin)
 - g. **Estimated Completion Date:** (estimated date construction will end)

- h. Has a Risk Assessment Been Completed:** (if yes attach copy)

- i. Security in Depth (SID) Documentation:** (Document the layers of protection offered at the site, such as security fencing or walls, roving guards, marine security guards, CCTV coverage, and controlled and/ or limited access buffers to facility)

- j. Adjacencies to Consider:** (include a description of adjacent facilities to include other classified agencies, activities, and presence of foreign nationals operating in adjacent spaces on all six sides of the proposed SCIF)

- k. Control of Construction Plans and Documents:** (Describe how construction plans and all related documents shall be handled and protected)

- l. Control of Operations if a Renovation Project** (describe barriers that will be installed to segregate construction workers from operational activities)

- m. Procurement, Shipping and Storage of Building/Finishing Material:** (If required by AO, describe security measures to ensure integrity of building materials and/ or finishing materials.)

- n. Construction Workers** (Depending upon the standards required (within U.S., outside U.S., etc.), for construction workers, provide information to verify worker status, clearances if required, and/ or mitigations employed.)

- o. Site Security** (Identify plans to secure construction site, to include any proposed fences, guards, CSTs, escorts, etc.)

- p. Security Administration:** (list security documentation and retention requirements that shall be maintained by the SSM (i.e. visitor logs, names of construction workers, security incident

Inspectable Construction Materials Checklist

Organization Name:

Project Name:

Contents

A. Foundation Materials	2
B. Masonry	2
C. Tools and Fasteners	2
D. Metal Items.....	3
E. Carpentry and Furniture.....	3
F. Thermal Moisture Protection	3
G. Doors and Windows (excluding locks)	4
H. Finishes	4
I. Plumbing and Mechanical Systems	4
J. Electrical Items	5
K. Other Miscellaneous	5

All items listed as “inspectable” may be procured locally using allotted random procurement percentages. All items that are “non-inspectable” must be procured in the US and securely shipped to the construction site.

A. Foundation Materials

* Note:

1. Aggregate cement, sand and gravel should be poured through an appropriate sized mesh, and a magnet should be utilized to occasionally check for inappropriate metallic particles.
2. At least 10% of the rebar should be examined for internal voids using ultrasonic testing. If the ultrasonic tester is unavailable, then destructive testing may be used.

DESCRIPTION	INSPECTABLE	INSPECTION METHOD				
Water	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Sand	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Cement	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Aggregate	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Gravel	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Rebar	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Rebar ties & mesh	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

B. Masonry

*Note:

1. Precast is not acceptable if created off site unless constructed in the US and shipped secure. If a CST inspects the precast as it is made, it is acceptable.
2. Stonework for the façade needs only visual inspection. Internal stone work must undergo a 3% random destruction test.
3. Scaffolding should be inspected internally before allowed on site.

DESCRIPTION	INSPECTABLE	INSPECTION METHOD				
Cement blocks & brick	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Precast concrete	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Stone Work	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Forms	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Scaffolding/work platforms	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

C. Tools and Fasteners

* Note:

Personal tool boxes will be examined when first brought on site, and randomly thereafter. They will be locked on the site when not in use and workers will not be allowed to carry them on and off the site.

DESCRIPTION	INSPECTABLE	INSPECTION METHOD				
Tool boxes	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Welding rod & solder	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Fasteners	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Hilti fasteners & charges	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

D. Metal Items

*Note:

Visual inspection applies only to common, commercially available items. Items requiring special fabrication are not inspectable unless CST is present during fabrication.

DESCRIPTION	INSPECTABLE	INSPECTION METHOD				
Structural Steel	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Metal Decking	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Metal Fabrications	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Metal Stairs	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

E. Carpentry and Furniture

*Note:

1. Finished and rough carpentry items constructed on site will be monitored by CSTs.
2. Furniture having built in electrical devices or lamps must be disassembled and inspected separately

DESCRIPTION	INSPECTABLE	INSPECTION METHOD				
Lumber	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Rough & finished carpentry	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Furniture w/out electrical raceway	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

F. Thermal Moisture Protection

*Note:

Metallic membranes preferred as they offer some degree of RF attenuation.

DESCRIPTION	INSPECTABLE	INSPECTION METHOD				
Water-proof membrane	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Water-proof membrane (Metallic)	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Bituminous water proofing	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Thermal Insulation	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Spray on Fire Proofing	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

G. Doors and Windows (excluding locks)

<u>DESCRIPTION</u>	<u>INSPECTABLE</u>	<u>INSPECTION METHOD</u>				
Metal Doors/Frames	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Wood Doors/Frames	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Metal Windows/Frames	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Wood Windows/Frames	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Vault Doors/Frames	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Glazing	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

H. Finishes

* Note:

Bundles of tiles will be unpacked and no more than two tiles at a time will be examined.

<u>DESCRIPTION</u>	<u>INSPECTABLE</u>	<u>INSPECTION METHOD</u>				
Plaster Lath	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Plaster	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Gypsum Wallboard	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Raised Flooring	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Carpet and Curtains	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Paint Varnishes	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Adhesives	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Wall Coverings	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Ceramic Tile	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Acoustical Tile	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

I. Plumbing and Mechanical Systems

* Note:

Can be inspected if no tape, insulation and/or other finishes have been used.

<u>DESCRIPTION</u>	<u>INSPECTABLE</u>	<u>INSPECTION METHOD</u>				
Plumbing (Metal)	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Plumbing (plastic)	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Plumbing fixtures	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Valves	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Fan Coil Units	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Site Fabricated Ducts	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Prefabricated Ducts	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

J. Electrical Items						
DESCRIPTION	INSPECTABLE	INSPECTION METHOD				
Wire	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Conduit	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Junction boxes	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Outlets w/out built ins	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Outlets w/built ins	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Switches, Breakers	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Incandescent light fixtures	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Florescent light fixtures	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Light bulbs (tubes)	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Circuit breaker boards	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Electrical component boards	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Transformers	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Transient suppressor	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Voltage regulators	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Generators	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Power line conditioners	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Switch gears	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Telephone systems	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

K. Other Miscellaneous						
DESCRIPTION	INSPECTABLE	INSPECTION METHOD				
Chalk & tack boards	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Fire extinguishers	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Fire alarm systems	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Fire alarm sensors	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Sprinkler/gas heads	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Kitchen appliances	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Electrical dark room equipment	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Security alarm systems	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Acoustical insulation	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test
Locks	<input type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> X-Ray	<input type="checkbox"/> Ultrasonic	<input type="checkbox"/> Visual	<input type="checkbox"/> Metal Detector	<input type="checkbox"/> Destructive Test

This page was intentionally left blank for duplex printing.

REQUEST FOR VISITOR TO OBTAIN UNESCORTED ACCESS TO BUCKLEY AIR FORCE BASE**PRIVACY ACT**

AUTHORITY: Title 10, United States Code 8012

PURPOSE: To assist security personnel in establishing a fitness determination through the identity proofing and vetting (background check) process.

INTENDED USE: To be utilized by personnel requesting to obtain guest installation access credential for unescorted access to Buckley Air Force Base (BAFB).

DISCLOSURE: Disclosure of requested information is voluntary; however, failure to provide information may result in denial of request or the refusal by the 460th Security Forces Squadron, Installation Access Control Section (460th SFS/S3IAC) to permit issuance of an installation access credential. By signing this application, the applicant understands if they lose or misplace their access credential, they will report the loss immediately to their sponsor and the Installation Access Control Section.

INSTRUCTIONS

1. Submit to 460th SFS/S3IAC in person. All information must be completed or the form will be denied.
2. Guest must present government issued photo ID in order to establish identity.
3. Sponsor MUST be registered in DBIDS and have a valid DD Form 577 on file prior to submitting form.

SECTION I: SPONSOR

1.1. SPONSOR NAME/ORGANIZATION REPRESENTATIVE (Last, First MI) Fattore, Riza P	1.2. SPONSOR UNIT/ORGANIZATION REPRESENTATIVE CONTACT PHONE U.S. Army Corps of Engineers,
1.3. DAYS/HOURS ACCESS REQUIRED Mon-Sat 0600-1800 20220105 - 20230104	1.4. REASON FOR INSTALLATION ACCESS Service Repairs at BLDG T1012

SECTION II: SPONSOREE

2.1. NAME (Last, First MI)	2.2. DATE OF BIRTH	2.3. DRIVER LICENSE NUMBER	2.4. STATE OF ISSUE
----------------------------	--------------------	----------------------------	---------------------

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER TITLE 18, UNITED STATES CODE, SECTION 1001 OR OTHER APPLICABLE LAWS AND REGULATIONS.

NOTE: "SPONSOR AND/OR GUEST" SHALL RETURN BADGE TO 460TH SFS/S3IAC UPON EXPIRATION.

2.5A. SPONSOR SIGNATURE	2.5B. DATE
2.6A. SPONSOREE SIGNATURE	2.6B. DATE

SECTION III: REQUEST JUSTIFICATION

3.1. DESCRIBE IN DETAIL WHY THE GUEST REQUIRES ACCESS TO BUCKLEY AIR FORCE BASE, TO INCLUDE LENGTH OF DURATION, FPCON CHARLIE JUSTIFICATION AND HOURS OF ACCESS. PLEASE IDENTIFY, BY BUILDING NUMBER, THE BUILDING HE/SHE REQUIRES ACCESS TO. YOUR RECOMMENDATION WILL BE REVIEWED BY THE NCOIC OF INSTALLATION ACCESS CONTROL AND/OR STAFF. THE FINAL DETERMINATION WILL BE MADE WHEN THE GUEST PROCESSES FOR HIS/HER BADGE.

Access to Buckley AFB is requested for the individual listed in Section II above in regards to the ongoing construction project on the installation being administered by the U.S. Army Corps of Engineers, Buckley Resident Office. The duration discussed in cell 1.3 is the anticipated length of time the construction project will be in active construction status (or 1 calendar year whichever is shorter).

The Contractor will need access during the hours of 0600-1800 Monday through Saturday including some federal holidays (no access requested on Thanksgiving, Christmas or New Years Day). The Contractor will be accessing the construction site for the project listed in cell 1.4 above.

SECTION IV: TO BE COMPLETED BY 460TH SECURITY FORCES INSTALLATION ACCESS CONTROL

4.1. NCIC/CCIC CHECK CONDUCTED ON:	4.2. ACCESS GRANTED Buckley AFB <input type="checkbox"/> YES <input type="checkbox"/> NO FPCON C <input type="checkbox"/> YES <input type="checkbox"/> NO	4.3. FOREIGN NATIONAL <input type="checkbox"/> YES <input type="checkbox"/> NO
4.4. DATE ISSUED	4.5. DATE EXPIRES	4.6. DBIDS CARD NUMBER

SECTION V: 460TH SFS INSTALLATION ACCESS CONTROL STAFF

5.1A. SIGNATURE	5.1B. DATE
-----------------	------------

***ALL SIGNATURE BLOCKS MUST BE SIGNED**

****THIS FORM IS VALID FOR 90 DAYS FROM DATE OF SIGNATURE**

This page was intentionally left blank for duplex printing.

REQUEST FOR VISITOR TO OBTAIN UNESCORTED ACCESS TO BUCKLEY AIR FORCE BASE

PRIVACY ACT

AUTHORITY: Title 10, United States Code 8012

PURPOSE: To assist security personnel in establishing a fitness determination through the identity proofing and vetting (background check) process.

INTENDED USE: To be utilized by personnel requesting to obtain guest installation access credential for unescorted access to Buckley Air Force Base (BAFB).

DISCLOSURE: Disclosure of requested information is voluntary; however, failure to provide information may result in denial of request or the refusal by the 460th Security Forces Squadron, Installation Access Control Section (460th SFS/S3IAC) to permit issuance of an installation access credential. By signing this application, the applicant understands if they lose or misplace their access credential, they will report the loss immediately to their sponsor and the Installation Access Control Section.

INSTRUCTIONS

1. Submit to 460th SFS/S3IAC in person. All information must be completed or the form will be denied.
2. Guest must present government issued photo ID in order to establish identity.
3. Sponsor MUST be registered in DBIDS and have a valid DD Form 577 on file prior to submitting form.

SECTION I: SPONSOR

1.1. SPONSOR NAME/ORGANIZATION REPRESENTATIVE (Last, First MI) Fattore, Riza P	1.2. SPONSOR UNIT/ORGANIZATION REPRESENTATIVE CONTACT PHONE U.S. Army Corps of Engineers, 720-692-6264
1.3. DAYS/HOURS ACCESS REQUIRED Mon - Sun 0001 - 2359 20220316 - 20230315, FPCON C	1.4. REASON FOR INSTALLATION ACCESS Construction Contractor: ADF Recap #3 (Construction Project)

SECTION II: SPONSOREE

2.1. NAME (Last, First MI)	2.2. DATE OF BIRTH	2.3. DRIVER LICENSE NUMBER	2.4. STATE OF ISSUE
----------------------------	--------------------	----------------------------	---------------------

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER TITLE 18, UNITED STATES CODE, SECTION 1001 OR OTHER APPLICABLE LAWS AND REGULATIONS.

NOTE: "SPONSOR AND/OR GUEST" SHALL RETURN BADGE TO 460TH SFS/S3IAC UPON EXPIRATION.

2.5A. SPONSOR SIGNATURE	2.5B. DATE
2.6A. SPONSOREE SIGNATURE	2.6B. DATE

SECTION III: REQUEST JUSTIFICATION

3.1. DESCRIBE IN DETAIL WHY THE GUEST REQUIRES ACCESS TO BUCKLEY AIR FORCE BASE, TO INCLUDE LENGTH OF DURATION, FPCON CHARLIE JUSTIFICATION AND HOURS OF ACCESS. PLEASE IDENTIFY, BY BUILDING NUMBER, THE BUILDING HE/SHE REQUIRES ACCESS TO. YOUR RECOMMENDATION WILL BE REVIEWED BY THE NCOIC OF INSTALLATION ACCESS CONTROL AND/OR STAFF. THE FINAL DETERMINATION WILL BE MADE WHEN THE GUEST PROCESSES FOR HIS/HER BADGE.

Access to Buckley AFB is requested for the individual listed in Section II above in regards to the ongoing construction project on the installation being administered by the U.S. Army Corps of Engineers, Buckley Resident Office. The duration discussed in cell 1.3 is the anticipated length of time the construction project will be in active construction status (or 1 calendar year whichever is shorter).

The Contractor will need access during the hours of 24/7 Monday through Sunday including all federal holidays. Due to the critical infrastructure the Contractor will be working on. FPCON Charlie access is also requested due to the critical infrastructure this Contractor will be working on. The Contractor will be accessing the construction site for the project listed in cell 1.4 above.

SECTION IV: TO BE COMPLETED BY 460TH SECURITY FORCES INSTALLATION ACCESS CONTROL

4.1. NCIC/CCIC CHECK CONDUCTED ON:	4.2. ACCESS GRANTED Buckley AFB <input type="checkbox"/> YES <input type="checkbox"/> NO FPCON C <input type="checkbox"/> YES <input type="checkbox"/> NO	4.3. FOREIGN NATIONAL <input type="checkbox"/> YES <input type="checkbox"/> NO
4.4. DATE ISSUED	4.5. DATE EXPIRES	4.6. DBIDS CARD NUMBER

SECTION V: 460TH SFS INSTALLATION ACCESS CONTROL STAFF

5.1A. SIGNATURE	5.1B. DATE
-----------------	------------

*ALL SIGNATURE BLOCKS MUST BE SIGNED

**THIS FORM IS VALID FOR 90 DAYS FROM DATE OF SIGNATURE

This page was intentionally left blank for duplex printing.

REQUEST FOR VISITOR TO OBTAIN UNESCORTED ACCESS TO BUCKLEY AIR FORCE BASE

PRIVACY ACT

AUTHORITY: Title 10, United States Code 8012

PURPOSE: *To assist security personnel in establishing a fitness determination through the identity proofing and vetting process.*

INTENDED USE: To be utilized by personnel requesting to obtain guest installation access pass for unescorted access to Buckley Air Force Base (BAFB) for 1-30 days or for special one time events.

DISCLOSURE: Disclosure of requested information is voluntary; however, failure to provide information may result in denial of request or the refusal by the 460th Security Forces Squadron, Installation Access Control Section to permit access to the installation.

INSTRUCTIONS

1. All information must be complete and in alphabetical order or the form will be denied.
2. Guest must present government/state ID in order to establish identity.
3. Sponsor must be registered in DBIDS prior to submitting form.
4. Must be submitted to Access Control Staff 72 hours prior to request.

SECTION I: SPONSOR INFORMATION

SPONSOR NAME (Last, First MI)

Fattore, Riza P

SPONSOR UNIT/CONTACT PHONE NUMBER

U.S. Army Corps of Engineers, 720-692-6264

DURATION OF REQUEST (MMDDYY-MMDDYY)

REASON FOR VISIT

SECTION II: GUEST INFORMATION

GUEST NAME (Last, First MI)

DOB (MMDDYY)

DRIVERS LICENSE NUMBER

ST

ACCESS - YES/NO

YES

YES

YES

SECTION III: TO BE COMPLETED BY 460TH SECURITY FORCES INSTALLATION ACCESS CONTROL STAFF

NCIC CHECK CONDUCTED ON

APPROVING OFFICIAL (Last, First MI)

SIGNATURE

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 30 00.24

OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS

07/20

PART 1 GENERAL

- 1.1 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE
- 1.2 CONTRACTOR SUPPLY AND USE OF ELECTRONIC SOFTWARE FOR PROCESSING
CONSTRUCTION WAGE RATE REQUIREMENTS STATUTE CERTIFIED LABOR
PAYROLLS
- 1.3 VETERANS EMPLOYMENT EMPHASIS FOR U.S. ARMY CORPS OF ENGINEERS
CONTRACTS
- 1.4 CONTRACTOR PERFORMANCE EVALUATIONS
- 1.5 ORDER OF WORK
- 1.6 MISSION DELAY DAYS
- 1.7 CONTRACT DRAWINGS AND SPECIFICATIONS
 - 1.7.1 SETS FURNISHED
 - 1.7.2 REPRODUCTION AND DISTRIBUTION
 - 1.7.3 NOTIFICATION OF DISCREPANCIES
 - 1.7.4 OMISSIONS
- 1.8 SUBMITTALS
- 1.9 CONCURRENT CONSTRUCTION
- 1.10 PAYMENT
 - 1.10.1 PROMPT PAYMENT ACT
 - 1.10.2 PAYMENT FOR MATERIALS STORED OFFSITE
 - 1.10.3 CONTRACTOR PAYROLL RECORD
- 1.11 AVAILABILITY OF UTILITY SERVICES
- 1.12 UTILITY SERVICE INTERRUPTIONS
- 1.13 DIGGING PERMITS AND ROAD CLOSINGS
- 1.14 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER
- 1.15 INSURANCE REQUIRED
- 1.16 SECURITY REQUIREMENTS
 - 1.16.1 Contractor's Employee Identification
 - 1.16.2 BASE ACCESS AND SECURITY
- 1.17 CONTRACTOR QUALITY CONTROL (CQC)
- 1.18 NONDOMESTIC CONSTRUCTION MATERIALS
- 1.19 DAILY WORK SCHEDULES AND WEEKLY COORDINATION MEETINGS
- 1.20 AS-BUILT DRAWINGS
- 1.21 SIGN
- 1.22 GOVERNMENT-FURNISHED PROPERTY
- 1.23 EQUIPMENT ROOM DRAWINGS
- 1.24 CONTRACTOR FURNISHED EQUIPMENT DATA
- 1.25 ASBESTOS AND LEAD
- 1.26 PARTNERING
 - 1.26.1 Facilitated (Formal) Partnering
- 1.27 PROFIT
- 1.28 LABOR CONDITIONS APPLICABLE TO TEMPORARY FACILITIES
- 1.29 DRAWING SCALES
- 1.30 FEDERAL HOLIDAYS
- 1.31 BASE HOURS

- 1.32 GPS SURVEY OF AS-BUILT UTILITY LINES/POINTS
- 1.33 COST AND TIME IMPACT (CTI) LOG

PART 2 NOT USED

PART 3 EXECUTION

- 3.1 APPENDIX A- CONTRACT DOCUMENT DISTRIBUTION LIST

ATTACHMENTS:

Appendix A - Contract Document Distribution List

Project Sign Details

AF103 - Base Civil Engineering Work Clearance Request

-- End of Section Table of Contents --

SECTION 01 30 00.24

OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS
07/20

PART 1 GENERAL

Attachments:

Appendix A - Contract Document Distribution List
Project Sign Details
AF103 - Base Civil Engineering Work Clearance Request

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 CONTRACTOR PERFORMANCE EVALUATIONS

See Federal Acquisition Regulation (FAR) Subpart 42.1502(e) for the requirements on past performance evaluations for construction contracts. For construction contracts valued at or above \$750,000.00, 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>.

1.5 ORDER OF WORK

Prior to any soil disturbing activities - i.e. any onsite construction, submit a pre-construction plan IAW the BSFB Specific Regulated Asbestos Contaminated Soil Management Plan (BSRMP) section 5.1 and 5.5. Refer to Sections 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES and 31 00 00 EARTHWORK.

See Section 01 14 00 WORK RESTRICTIONS for additional requirements.

1.6 MISSION DELAY DAYS

Anticipate a work delay of up to 15 days during the contract period due to Using Service operations. The Contractor will be notified one week in advance of these interruptions. This time is included in the overall completion time stated.

1.7 CONTRACT DRAWINGS AND SPECIFICATIONS

1.7.1 SETS FURNISHED

Make copies of conformed specifications with amendments or changes 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) is 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.

1.7.2 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 consisting of 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.

1.7.3 NOTIFICATION OF DISCREPANCIES

Check all electronically-sent 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 and will be responsible for any errors which might have been avoided thereby.

1.7.4 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.

1.8 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-02 Shop Drawings

Equipment Room Drawings; G-RO.

1.9 CONCURRENT CONSTRUCTION

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

1.10 PAYMENT

1.10.1 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.

1.10.2 PAYMENT FOR MATERIALS STORED OFFSITE

a. As allowed under (FAR) 52.232-5 "Payments Under Fixed Price Construction Contracts", the Administrative Contracting Officer, at their discretion, may authorize progress payments for any material stored

off-site provided:

- (1) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract,
- (2) Material is stored in such a manner to protect it from damage, fire, theft, etc.
- (3) The Contractor provides evidence of insurance for material, and,
- (4) Material is clearly identified and delineated by contract number for use on the applicable project.

b. The Administrative Contracting Officer reserves the right to inspect any off-site material prior to authorizing progress payments. Provide paid invoices listing the value of material and labor incorporated in the items.

1.10.3 CONTRACTOR PAYROLL RECORD

Log payrolls for all contractor employees and subcontractors utilizing ENG Form 3180. Each subcontractor requires a separate ENG 3180 for their payrolls. Maintain the ENG 3180, along with the payrolls, on site and make available for review by the Contracting Officer's Representative. Update the ENG 3180's weekly as payrolls are submitted. After making copies for their files, submit the originals of each week's payrolls to the Resident Office. Before final payment, provide the completed ENG 3180's to the Contracting Officer's Representatives. If the Contractor has elected to use an electronic payroll system, as described in paragraph CONSTRUCTION SUPPLY AND USE OF ELECTRONIC SOFTWARE FOR PROCESSING CONSTRUCTION WAGE RATE REQUIREMENTS STATUTE CERTIFIED LABOR PAYROLLS, the payroll inventory produced by the electronic payroll system will satisfy the requirements in this paragraph and FAR 52.222-8, Payrolls and Basic Records.

1.11 AVAILABILITY OF UTILITY SERVICES

Install meters to determine the amount of electricity, water, gas, etc. used by the Contractor. Make arrangements with the Using Service, through the Contracting Officer, as to the method of payment of utilities used. Make all temporary connections and install distribution lines and pay all associated expenses. 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. Maintain all temporary lines in a workmanlike manner satisfactory to the Contracting Officer and remove in like manner prior to final acceptance of the construction. The Government will furnish normal quantities of electricity and water used to make final tests of completely installed systems.

1.12 UTILITY SERVICE INTERRUPTIONS

Submit written notification not less than 21 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.

1.13 DIGGING PERMITS AND ROAD CLOSINGS

Allow 14 calendar days from date of written application to receive permission to dig and to close roads. 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.

1.14 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	5
Feb	5
Mar	3
Apr	4
May	3
Jun	4
Jul	3
Aug	3
Sep	2
Oct	3
Nov	3
Dec	7

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)

1.15 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)

1.16 SECURITY REQUIREMENTS

1.16.1 Contractor's Employee Identification

Furnish to each employee and require 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 or Lawful Residents will be permitted to enter. Proof of U.S. citizenship or Lawful Residency 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)

1.16.2 BASE ACCESS AND SECURITY

See Section 01 14 00 WORK RESTRICTIONS.

1.17 CONTRACTOR QUALITY CONTROL (CQC)

See Section 01 45 00.00 10 QUALITY CONTROL.

1.18 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.

1.19 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. Develop all schedules in accordance with Section 01 32 01.00 10 PROJECT SCHEDULE. 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.

1.20 AS-BUILT DRAWINGS

See SECTIONS 01 78 39.00 24 - AS-BUILT DRAWINGS and 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/CAD) REQUIREMENTS for requirements.

1.21 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 attached to this section. A decal of the "Engineer Castle" and the U. S. Air Force emblem will be furnished the Contractor upon request.

1.22 GOVERNMENT-FURNISHED PROPERTY

Pursuant to CONTRACT CLAUSES clause: "Government Property " the Government will furnish to the Contractor the following property to be incorporated or installed in the work. Such property will be furnished f.o.b. or from warehouse at the project site and the Contractor must accept delivery when made, and unload and transport the property to the jobsite at their own expense. All such property must be installed or incorporated into the work at the expense of the Contractor. Verify the quantity and condition of such Government-furnished property when delivered to him and report the receipt of Government-Furnished Property in accordance with GENERAL CONDITIONS (CONTRACT CLAUSES) DFARS 252.211-7007 REPORTING OF GOVERNMENT-FURNISHED PROPERTY. For damage or loss or property follow GENERAL CONDITIONS (CONTRACT CLAUSES) DFARS 252.245-7002 REPORTING LOSS OF GOVERNMENT PROPERTY.

Quantity	Item	Description
	see FF&E package	

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 ASBESTOS AND LEAD

a. The Contractor is warned that inhalation of asbestos has been associated with health hazards.

b. Asbestos-containing materials have been identified 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 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES.

1.26 PARTNERING

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

1.26.1 Facilitated (Formal) Partnering

- a. Within 45 calendar days after award and prior to the start of work, or as coordinated with and approved by the Government, host a Formal Partnering session with key personnel from the project team including both Contractor and Government personnel. All costs associated with the Partnering session including the third-party independent Facilitator Consultant, meeting room and other incidental items are the responsibility of the Contractor.
- b. Before the Facilitated (Formal) Partnering session, coordinate with the Facilitator all requirements for incidental items (such as audio-visual equipment, easels, flipchart paper, colored markers, note pads, pens/pencils, colored flash cards) and have these items

available at the Partnering session. Provide copies of any documents required for distribution to all attendees. Participants will bear their own costs for meals, lodging and transportation associated with Partnering.

- c. The Initial Partnering Session must be a duration of one day and be held at a location off base as agreed to by the Contracting Officer. Partnering session may take place concurrently with the Pre-Construction Meeting.
- d. Facilitator must be experienced in conducting corporate Partnering sessions and must be a third-party independent facilitating consultant - not an employee of the Contractor. The Facilitator is responsible for leading all aspects of the Partnering session necessary to achieve the Partnering goal.
- e. An outcome of the Partnering session must be an escalation matrix agreed upon by both the Government and Contractor, which identifies key Government and Contractor decision makers by name and anticipated decision durations.
- f. Host follow-on Partnering Sessions at three- to six-month intervals or more frequently if needed and lasting generally a half day or less. Attendees need only be those required to resolve current issues. The same Facilitator used in the Initial Partnering session must lead the follow-on sessions unless an alternative is permitted by the Contractor Officer. All costs associated with follow-on Partnering sessions are the responsibility of the Contractor.

1.27 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.

1.28 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" is applicable to such operations.

1.29 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.

1.30 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.

1.31 BASE HOURS

Base operation hours are 6:00 a.m. to 6:00 p.m. daily (Monday through Friday), excluding federal holidays. 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.

1.32 GPS SURVEY OF AS-BUILT UTILITY LINES/POINTS

Locate all new underground utility lines (including electrical power and communications, gas, water, sanitary sewer, storm drains, roof drains, and culverts) during installation using Global Positioning Satellite (GPS) surveying equipment. See 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/CAD) REQUIREMENTS for additional information.

1.33 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

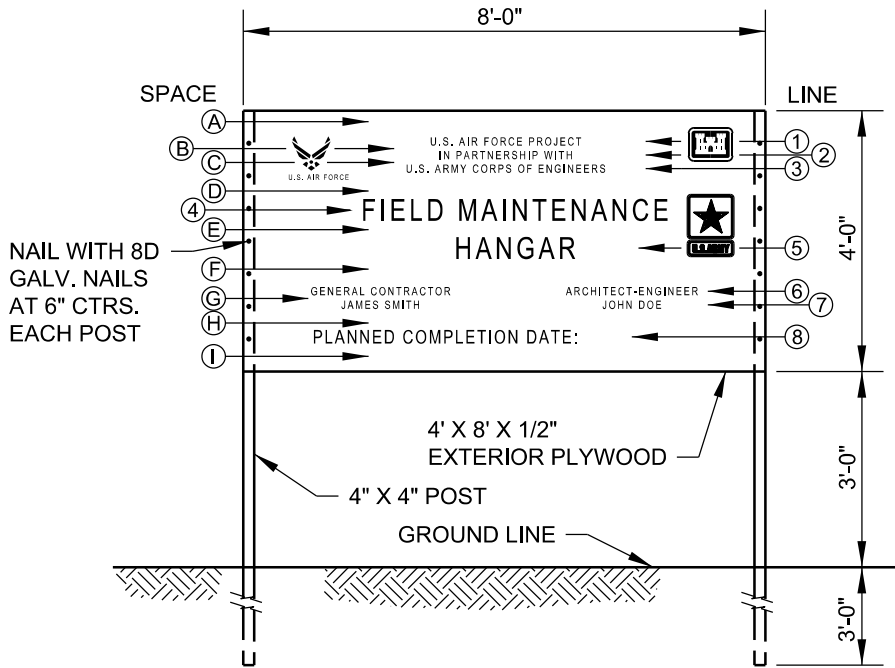
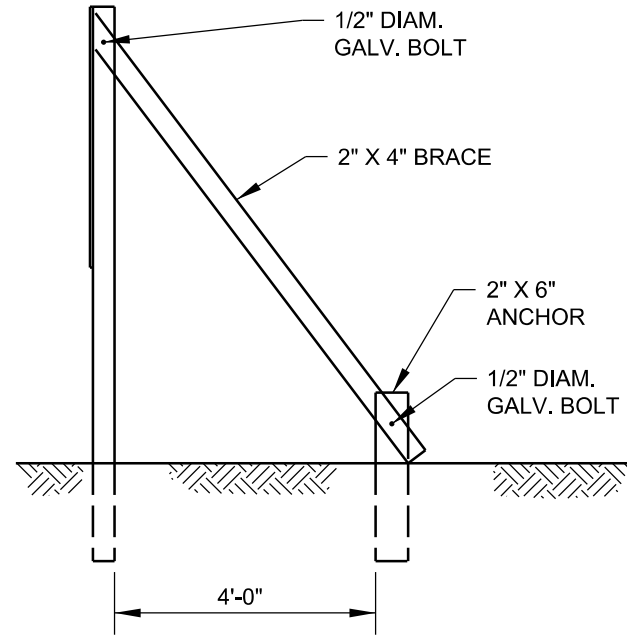
3.1 APPENDIX A- CONTRACT DOCUMENT DISTRIBUTION LIST

Appendix A - Contract Document Distribution List

Addressee Address	No. of Sets			
	CD/DVD	Drawings		Specs
		Full-size	Half Size	
NSA (Attn: Chaundra Richardson) 8218 Crab Apple Ct Glen Burnie, MD 21061	0	0	10	10
Denver Area Office(Attn: Frank Soto) 19070 E Sunlight Way T1012, Buckley Space Force Base, CO 80011-9574	2	2	2	2
TOTAL COPIES	2 CD/DVD	2 Full-size	12 Half-Size	12 Specs

-- End of Section --

This page was intentionally left blank for duplex printing.

**FRONT VIEW****END VIEW**

U.S. AIR FORCE MCP PROJECTS

PROJECT SIGN DETAILS

NO SCALE

SCHEDULE

SPACE	HEIGHT	LINE	DESCRIPTION	LETTER HEIGHT	STROKE
A	4"	1	U.S. AIR FORCE PROJECT	1.5"	3/16"
B	2"	2	IN PARTNERSHIP WITH	1.5"	3/16"
C	2"	3	U.S. ARMY CORPS OF ENGINEERS	1.5"	3/16"
D	5"	4	PROJECT NAME	4"	1/2"
E	3"	5	PROJECT NAME CONT'D (IF REQ'D)	4"	1/2"
F	5"	6	GENERAL CONTRACTOR/A-E	1.5"	3/16"
G	1"	7	GENERAL CONTRACTOR/A-E	1.5"	3/16"
H	4"	8	PLANNED COMPLETION DATE	2.5"	1/4"
I	4"				

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 TWO COATS EXTERIOR TYPE ALKYD, CONFORMING TO MASTER PAINTERS INSTITUTE MPI-9, MPI GLOSS LEVEL 6. COLOR SHALL MATCH EITHER BENJAMIN MOORE CARIBBEAN AZURE (2059-20) OR PITTSBURGH PAINTS WARM WASSAIL (428-7) AS DIRECTED BY THE CONTRACTING OFFICER'S REPRESENTATIVE.
5. ALL LETTERING SHALL BE EXTERIOR TYPE ALKYD. COLOR SHALL BE WHITE.
6. DECALCOMANIA FOR CORPS OF ENGINEERS INSIGNIA, U.S. ARMY STAR, AND U.S. AIR FORCE EMBLEM WILL BE FURNISHED BY THE CONTRACTING OFFICER FOR INSTALLATION BY THE CONTRACTOR.
7. ALL EXPOSED WOOD (POSTS, SUPPORTS, BACK, ETC.) SHALL BE PAINTED THE SAME BACKGROUND COLOR AS THE SIGN.
8. LETTERING STYLE SHALL BE EITHER HELIOS EXTRA BOLD CONDENSED, HELIOS BOLD II, HELVETICA BLACK ROMAN, OR HELVETICA BOLD ROMAN.

This page was intentionally left blank for duplex printing.

BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST <i>(See Instructions on Reverse)</i>		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 <input type="checkbox"/> has <input type="checkbox"/> has not been staked or clearly marked.											
2. TYPE OF FACILITY/WORK INVOLVED <table style="width: 100%; border: none;"> <tr> <td style="border: none;"><input type="checkbox"/> A. PAVEMENTS</td> <td style="border: none;"><input type="checkbox"/> D. FIRE DETECTION & PROTECTION SYSTEMS</td> <td style="border: none;"><input type="checkbox"/> G. AIRCRAFT OR VEHICULAR TRAFFIC FLOW</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> B. DRAINAGE SYSTEMS</td> <td style="border: none;"><input type="checkbox"/> E. UTILITY <input type="checkbox"/> OVERHEAD <input type="checkbox"/> UNDERGROUND</td> <td style="border: none;"><input type="checkbox"/> H. SECURITY</td> </tr> <tr> <td style="border: none;"><input type="checkbox"/> C. RAILROAD TRACKS</td> <td style="border: none;"><input type="checkbox"/> F. COMM <input type="checkbox"/> OVERHEAD <input type="checkbox"/> UNDERGROUND</td> <td style="border: none;"><input type="checkbox"/> I. OTHER</td> </tr> </table>			<input type="checkbox"/> A. PAVEMENTS	<input type="checkbox"/> D. FIRE DETECTION & PROTECTION SYSTEMS	<input type="checkbox"/> G. AIRCRAFT OR VEHICULAR TRAFFIC FLOW	<input type="checkbox"/> B. DRAINAGE SYSTEMS	<input type="checkbox"/> E. UTILITY <input type="checkbox"/> OVERHEAD <input type="checkbox"/> UNDERGROUND	<input type="checkbox"/> H. SECURITY	<input type="checkbox"/> C. RAILROAD TRACKS	<input type="checkbox"/> F. COMM <input type="checkbox"/> OVERHEAD <input type="checkbox"/> UNDERGROUND	<input type="checkbox"/> I. OTHER
<input type="checkbox"/> A. PAVEMENTS	<input type="checkbox"/> D. FIRE DETECTION & PROTECTION SYSTEMS	<input type="checkbox"/> G. AIRCRAFT OR VEHICULAR TRAFFIC FLOW									
<input type="checkbox"/> B. DRAINAGE SYSTEMS	<input type="checkbox"/> E. UTILITY <input type="checkbox"/> OVERHEAD <input type="checkbox"/> UNDERGROUND	<input type="checkbox"/> H. SECURITY									
<input type="checkbox"/> C. RAILROAD TRACKS	<input type="checkbox"/> F. COMM <input type="checkbox"/> OVERHEAD <input type="checkbox"/> UNDERGROUND	<input type="checkbox"/> I. OTHER									
3. DATE CLEARANCE REQUIRED		4. DATE OF CLEARANCE									
5. SIGNATURE OF REQUESTING OFFICIAL		6. TELEPHONE NO.									
7. ORGANIZATION											
ORGANIZATION	REMARKS <i>(Use Reverse for additional comments)</i>	REVIEWER'S NAME AND INITIALS									
8. B A S E C I V I L E N G I N E E R I N G	A. ELECTRICAL DISTRIBUTION B. STEAM DISTRIBUTION C. WATER DISTRIBUTION D. POL DISTRIBUTION E. SEWER DISTRIBUTION F. ENVIRONMENTAL G. PAVEMENTS/ GROUNDS H. FIRE PROTECTION I. ZONE _____ J. OTHER <i>(Specify)</i>										
9. SECURITY POLICE											
10. SAFETY											
11. COMMUNICATIONS											
12. BASE OPERATIONS											
13. CABLE TV											
14. COMMERCIAL UTILITY COMPANY <input type="checkbox"/> TELEPHONE <input type="checkbox"/> GAS <input type="checkbox"/> ELECTRIC											
15. OTHER <i>(Specify)</i> _____											
16. REQUESTED CLEARANCE <input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED											
17. TYPED NAME AND SIGNATURE OF APPROVING OFFICER <i>(Chief of Operations Flight or Chief of Engineering Flight)</i>		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.)*

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 32 01.00 10

PROJECT SCHEDULE

02/15

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 PROJECT SCHEDULER QUALIFICATIONS

PART 2 PRODUCTS

- 2.1 SOFTWARE
 - 2.1.1 Government Default Software
 - 2.1.2 Contractor Software
 - 2.1.2.1 Primavera
 - 2.1.2.2 Other Than Primavera

PART 3 EXECUTION

- 3.1 GENERAL REQUIREMENTS
- 3.2 BASIS FOR PAYMENT AND COST LOADING
 - 3.2.1 Activity Cost Loading
 - 3.2.2 Withholdings / Payment Rejection
- 3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS
 - 3.3.1 Level of Detail Required
 - 3.3.2 Activity Durations
 - 3.3.3 Procurement Activities
 - 3.3.4 Mandatory Tasks
 - 3.3.5 Government Activities
 - 3.3.6 Standard Activity Coding Dictionary
 - 3.3.6.1 Workers Per Day (WRKP)
 - 3.3.6.2 Responsible Party Coding (RESP)
 - 3.3.6.3 Area of Work Coding (AREA)
 - 3.3.6.4 Modification Number (MODF)
 - 3.3.6.5 Bid Item Coding (BIDI)
 - 3.3.6.6 Phase of Work Coding (PHAS)
 - 3.3.6.7 Category of Work Coding (CATW)
 - 3.3.6.8 Feature of Work Coding (FOW)
 - 3.3.7 Contract Milestones and Constraints
 - 3.3.7.1 Project Start Date Milestone and Constraint
 - 3.3.7.2 End Project Finish Milestone and Constraint
 - 3.3.7.3 Interim Completion Dates and Constraints
 - 3.3.7.3.1 Start Phase
 - 3.3.7.3.2 End Phase
 - 3.3.8 Calendars
 - 3.3.9 Open Ended Logic
 - 3.3.10 Default Progress Data Disallowed
 - 3.3.11 Out-of-Sequence Progress
 - 3.3.12 Added and Deleted Activities

- 3.3.13 Original Durations
- 3.3.14 Leads, Lags, and Start to Finish Relationships
- 3.3.15 Retained Logic
- 3.3.16 Percent Complete
- 3.3.17 Remaining Duration
- 3.3.18 Cost Loading of Closeout Activities
 - 3.3.18.1 As-Built Drawings
 - 3.3.18.2 O & M Manuals
- 3.3.19 Early Completion Schedule and the Right to Finish Early
- 3.4 PROJECT SCHEDULE SUBMISSIONS
 - 3.4.1 Preliminary Project Schedule Submission
 - 3.4.2 Initial Project Schedule Submission
 - 3.4.3 Periodic Schedule Updates
- 3.5 SUBMISSION REQUIREMENTS
 - 3.5.1 Submission
 - 3.5.2 Narrative Report
 - 3.5.3 Schedule Reports
 - 3.5.3.1 Activity Report
 - 3.5.3.2 Logic Report
 - 3.5.3.3 Total Float Report
 - 3.5.3.4 Earnings Report by CLIN
 - 3.5.3.5 Schedule Log
 - 3.5.3.6 Critical Path
 - 3.5.4 Network Diagram
 - 3.5.4.1 Continuous Flow
 - 3.5.4.2 Project Milestone Dates
 - 3.5.4.3 Critical Path
 - 3.5.4.4 Banding
 - 3.5.4.5 Cash Flow / Schedule Variance Control (SVC) Diagram
- 3.6 PERIODIC SCHEDULE UPDATE
 - 3.6.1 Periodic Schedule Update Meetings
 - 3.6.2 Update Submission Following Progress Meeting
- 3.7 WEEKLY PROGRESS MEETINGS
- 3.8 REQUESTS FOR TIME EXTENSIONS
 - 3.8.1 Justification of Delay
 - 3.8.2 Time Impact Analysis (Prospective Analysis)
 - 3.8.3 Forensic Schedule Analysis (Retrospective Analysis)
 - 3.8.4 Fragmentary Network (Fragnet)
 - 3.8.5 Time Extension
 - 3.8.6 Impact to Early Completion Schedule
- 3.9 FAILURE TO ACHIEVE PROGRESS
 - 3.9.1 Artificially Improving Progress
 - 3.9.2 Failure to Perform
 - 3.9.3 Recovery Schedule
- 3.10 OWNERSHIP OF FLOAT
- 3.11 TRANSFER OF SCHEDULE DATA INTO RMS
- 3.12 PRIMAVERA P6 MANDATORY REQUIREMENTS

-- End of Section Table of Contents --

SECTION 01 32 01.00 10

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	(1995) Administration -- Progress, Schedules, and Network Analysis Systems
-----------	---

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. 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 Clauses . 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 --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 00

SUBMITTAL PROCEDURES

08/18, OMH 02/2021

PART 1 GENERAL

- 1.1 SUMMARY
 - 1.1.1 Submittal Information
 - 1.1.2 Project Type
 - 1.1.3 Submission of Submittals
- 1.2 DEFINITIONS
 - 1.2.1 Submittal Descriptions (SD)
 - 1.2.2 Approving Authority
 - 1.2.3 Work
- 1.3 SUBMITTALS
 - 1.3.1 Action Codes
 - 1.3.1.1 Contractor Action Codes
 - 1.3.1.2 Government Reviewer Designations
- 1.4 SUBMITTAL CLASSIFICATION
 - 1.4.1 Government Approved (G)
 - 1.4.2 For Information Only
 - 1.4.3 Sustainability Reporting Submittals
- 1.5 PREPARATION
 - 1.5.1 Transmittal Form
 - 1.5.2 Submittal Format
 - 1.5.2.1 Format of SD-01 Preconstruction Submittals
 - 1.5.2.2 Format for SD-02 Shop Drawings
 - 1.5.2.2.1 Drawing Identification
 - 1.5.2.3 Format of SD-03 Product Data
 - 1.5.2.3.1 Product Information
 - 1.5.2.3.2 Standards
 - 1.5.2.3.3 Data Submission
 - 1.5.2.4 Format of SD-04 Samples
 - 1.5.2.4.1 Sample Characteristics
 - 1.5.2.4.2 Sample Incorporation
 - 1.5.2.4.3 Comparison Sample
 - 1.5.2.5 Format of SD-05 Design Data
 - 1.5.2.6 Format of SD-06 Test Reports
 - 1.5.2.7 Format of SD-07 Certificates
 - 1.5.2.8 Format of SD-08 Manufacturer's Instructions
 - 1.5.2.8.1 Standards
 - 1.5.2.9 Format of SD-09 Manufacturer's Field Reports
 - 1.5.2.10 Format of SD-10 Operation and Maintenance Data (O&M)
 - 1.5.2.11 Format of SD-11 Closeout Submittals
 - 1.5.3 Source Drawings for Shop Drawings
 - 1.5.3.1 Source Drawings
 - 1.5.3.2 Terms and Conditions
 - 1.5.4 Electronic File Format
- 1.6 QUANTITY OF SUBMITTALS
 - 1.6.1 Number of SD-04 Samples

- 1.7 INFORMATION ONLY SUBMITTALS
- 1.8 PROJECT SUBMITTAL REGISTER
 - 1.8.1 Submittal Management
 - 1.8.2 Preconstruction Use of Submittal Register
 - 1.8.3 Contractor Use of Submittal Register
 - 1.8.4 Approving Authority Use of Submittal Register
 - 1.8.5 Action Codes
 - 1.8.6 Delivery of Copies
- 1.9 VARIATIONS
 - 1.9.1 Considering Variations
 - 1.9.2 Proposing Variations
 - 1.9.3 Warranting that Variations are Compatible
 - 1.9.4 Review Schedule Extension
- 1.10 SCHEDULING
- 1.11 GOVERNMENT APPROVING AUTHORITY
 - 1.11.1 Review Notations
- 1.12 DISAPPROVED SUBMITTALS
- 1.13 APPROVED SUBMITTALS
- 1.14 APPROVED SAMPLES
- 1.15 WITHHOLDING OF PAYMENT
- 1.16 CERTIFICATION OF SUBMITTAL DATA

PART 2 PRODUCTS

PART 3 EXECUTION

ATTACHMENTS:

ENG Form 4025

Project Submittal Register

-- End of Section Table of Contents --

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:

Michael Hebert
 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, the Contractor is to 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. .

- 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.

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 within each submittal accurately conforms with the requirements of the contract documents.

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

1.14 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not to be construed to change or modify any contract requirements. Before submitting samples, provide assurance that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

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

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

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

1.15 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

Joint Cryptologic Center Building - Buckley SFB, CO

BU81

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N A / E R E V I O W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 14 00	SD-01 Preconstruction Submittals														
			Project Security And Site Access Management Plan	1.4	G RO												
		01 30 00.24	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 and Sustainable Building Checklist	1.5.3.2	G S												
			Sustainability Action Plan	1.4.1	G S												
			Preliminary Sustainability eNotebook	1.5.3.2	G S												
			SD-11 Closeout Submittals														
			Final High Performance and Sustainable Building Checklist	1.5.3.2	G S												
			Final Sustainability eNotebook	1.5.3.2	G S												
			Energy Efficient Products	1.6.2													
			Energy Efficient Products	1.6.2													
			Indoor Water Use	1.6.4													
			Low Emitting Materials	3.3													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 33 29	Bio-Based Products	1.6.10													
			Recycled Content	1.6.9													
			Certification of EPA Designated Items	1.6.9.1													
			USDA BioPreferred Program Certification	1.6.10													
			Sustainability Submittals	1.5													
			Sustainability Submittals	1.5.3													
			Amended Final Sustainability eNotebook	1.5.3.2	G S												
			Amended Final High Performance and Sustainable Building Checklist	1.5.3.2	G S												
			Third Party Certification Certificate, Assessment, or Validation and Compliance Report	3.2	G S												
		01 33 39.00 10	SD-01 Preconstruction Submittals														
			Advanced Modeling Project Execution Plan (PxP)	1.4.1	G												
			PxP Demonstration	1.4.2	G												
			SD-03 Product Data														
			Advanced Modeling Submittals	1.4.3	G												
			SD-11 Closeout Submittals														
			Final Design And Final Record Submittal	3.2	G												
			As-built Drawings	3.5	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION REVIEW OR E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 35 26	SD-01 Preconstruction Submittals														
			ACCIDENT PREVENTION PLAN (APP)	1.7.1	G RO												
			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													
			Hot Work Permit	1.9.1													
			Certificate of Compliance	1.12.4													
			License Certificates	1.14													
		01 35 29.13	SD-01 Preconstruction Submittals														
			Project-Specific RACS	1.4													
			Management Plan (PSRMP)														
			SD-02 Shop Drawings														
			Work Zones	3.8.1	G RO												
			Decontamination Facilities	3.9.1	G RO												
			SD-03 Product Data														
			Exposure Monitoring/Air Sampling Program	3.5													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 35 29.13	Site Control Log	3.8.2													
			SSHO's Daily Inspection Logs	1.9													
			amendments to the APP/SSHP	1.5													
			SD-07 Certificates														
			Certificate Of CABI Training	1.8													
			SD-11 Closeout Submittals														
			Safety And Health Phase-Out Report	1.10													
		01 41 26.05 24	SD-01 Preconstruction Submittals														
			Inspector Qualifications	3.2.4.1													
		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-06 Test Reports														
			Daily Reports	3.1.2													
			Biweekly Reports	3.1.1													
			SD-07 Certificates														
			AISC Certified Steel Fabricator	2.1													
			Certificate of Compliance	2.1													
			Special Inspector	1.5	G												
			SD-11 Closeout Submittals														
			Interim Report	3.1.2	G												
			Comprehensive Final Report	3.1.2	G												
		01 57 20.00 10	SD-01 Preconstruction Submittals														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V I O W N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 57 20.00 10	Environmental Protection Plan	1.8	G RO												
		01 57 23.00 10	SD-07 Certificates														
			Mill Certificate or Affidavit	2.1.3													
		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	G RO												
		01 78 23	SD-10 Operation and Maintenance Data														
			O&M Database	1.3.5	G RO												
			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														
			Training Video Recording	3.1.4	G RO												
			Validation of Training Completion	3.1.6	G RO												
		01 78 24.00 10	SD-01 Preconstruction Submittals														
			Facility Data Project Execution Plan	1.5.1													
			SD-10 Operation and Maintenance Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	CLASSIFICATION GOVT OR CLASSIFIED REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 78 24.00 10	Facility Data Workbook, Construction Progress	3.1	G												
			Facility Document Set, Construction Progress	3.1	G												
			SD-11 Closeout Submittals														
			Facility Data Workbook, Construction Final	3.2	G												
			Facility Document Set, Construction Final	1.5.3	G												
			Facility Document Set, Construction Final	3.2	G												
		01 78 36.00 24	SD-11 Closeout Submittals														
			Equipment Warranty Booklet	1.2.5													
		01 78 39.00 24	SD-03 Product Data														
			50 Percent Preliminary As-Built Drawings	1.6.2	G DO												
			100 Percent Preliminary As-Built Drawings	1.6.3	G DO												
			SD-11 Closeout Submittals														
			Final As-Built Drawings	1.6.4	G DO												
			Sustainability Documentation	1.4.3	G AE												
		01 91 00.15 10	SD-01 Preconstruction Submittals														
			Commissioning Firm	1.7	G RO												
			Lead Commissioning Specialist	1.7.1	G RO												
			Technical Commissioning Specialists	1.7.2	G RO												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V I O W N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 91 00.15 10	Commissioning Firm's Contract	1.7	G DO												
			SD-06 Test Reports														
			Design Review Report	3.1.3	G DO												
			Interim Construction Phase	3.1.2.1	G RO												
			Commissioning Plan														
			Final Construction Phase	3.1.2.2	G RO												
			Commissioning Plan														
			Template Building Envelope	3.1.2.1.2	G RO												
			Inspection Checklists														
			Building Envelope Inspection	3.1.5.2	G RO												
			Checklists														
			Pre-Functional Checklists	3.1.5.3	G RO												
			Issues Log	1.9													
			Commissioning Report	3.2	G RO												
			Post-Construction Trend Log	3.3.1	G RO												
			Report														
			SD-07 Certificates														
			Certificate of Readiness	1.10	G RO												
			SD-10 Operation and Maintenance														
			Data														
			Training Plan	3.1.6	G RO												
			Training Attendance Rosters	3.1.6	G RO												
			Systems Manual	3.1.7	G DO												
			Maintenance and Service Life	3.1.8	G RO												
			Plans														
			SD-11 Closeout Submittals														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION OR REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		01 91 00.15 10	Final Commissioning Report	3.2	S RO												
			Final Construction Phase	3.1.2.2	S												
			Commissioning Plan														
		02 41 00	SD-01 Preconstruction Submittals														
			Demolition Plan	1.2.2	G												
			Existing Conditions	1.9													
			SD-07 Certificates														
			Notification	1.6	G												
		03 30 00	SD-01 Preconstruction Submittals														
			Concrete Curing Plan	1.6.3.1													
			Quality Control Plan	1.6.5	G												
			Quality Control Personnel	1.6.6	G												
			Certifications														
			Quality Control Organizational	1.6.6													
			Chart														
			Laboratory Accreditation	1.6.8	G												
			Maturity Method Data	3.3.8													
			SD-02 Shop Drawings														
			Formwork	1.6.2.1													
			Reinforcing Steel	1.6.2.2	G AE												
			SD-03 Product Data														
			Joint Sealants	2.4.5	S												
			Joint Filler	2.4.4													
			Formwork Materials	2.1													
			Recycled Aggregate Materials	2.3.3.3	S												
			Cementitious Materials	2.3.1	S												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V I E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 00	Vapor Retarder	2.4.6													
			Concrete Curing Materials	2.4.1													
			Recycled Content for Steel	1.7.1	S												
			Reinforcement														
			Liquid Chemical Floor Hardeners	2.4.3.1													
			and Sealers														
			Admixtures	2.3.4													
			Mechanical Reinforcing Bar	2.6.2													
			Connectors														
			Waterstops	2.2.2													
			Biodegradable Form Release	2.2.3	S												
			Agent														
			Pumping Concrete	1.6.3.2													
			Nonshrink Grout	2.4.2													
			SD-05 Design Data														
			Concrete Mix Design	1.6.1.2	G												
			Formwork Calculations	1.6.1.1													
			SD-06 Test Reports														
			Concrete Mix Design	1.6.1.2	G												
			Fly Ash	1.6.4.1													
			Pozzolan	1.6.4.1													
			Slag Cement	1.6.4.2													
			Aggregates	1.6.4.3													
			Tolerance Report	3.10.2.1													
			Compressive Strength Tests	3.14.3.3	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REVIEW WR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		03 30 00	Unit Weight of Structural Concrete	3.14.3.5													
			Chloride Ion Concentration	3.14.3.6													
			Air Content	3.14.3.4													
			Slump Tests	3.14.3.1													
			Water	2.3.2													
			SD-07 Certificates														
			Reinforcing Bars	2.6.1													
			Indoor Air Quality for Joint Sealants and Adhesives	1.6.3.3	S												
			Indoor Air Quality for Concrete Curing Compound	1.6.3.3	S												
			Indoor Air Quality for Waterproofing Sealer	1.6.3.3	S												
			Indoor Air Quality for Form Release Agent	1.6.3.3	S												
			Indoor Air Quality Certification	1.6.3.3													
			Safety Data Sheets	1.6.3.4													
			Field Testing Technician and Testing Agency	1.6.6.2													
			SD-08 Manufacturer's Instructions														
			Liquid Chemical Floor Hardeners and Sealers	2.4.3.1													
			Joint Sealants	2.4.5													
			Curing Compound	2.4.1													
		04 20 00	SD-02 Shop Drawings														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		04 20 00	Cut CMU	3.3.3.1	G												
			Detail Drawings	3.4.1.1	G												
			SD-03 Product Data														
			Concrete masonry units	1.4.1	G												
			Concrete masonry units	2.2.2.5	G												
			Reinforcement, Anchors, and Ties	1.4.2	G												
			Hot Weather Procedures	1.5.1	G												
			Cold Weather Procedures	1.5.2	G												
			Cement	2.2.2.2.1	G												
			Cementitious Materials	2.4.1.1	G												
			Recycled Content for Steel Reinforcement	2.6.4	S												
			Recycled Content for Concrete Masonry Units	2.2.2.2.2	S												
			SD-04 Samples														
			Mock-Up Panel	1.3.2.1	G												
			Concrete Masonry Units (CMU)	2.2.2.2	G												
			Admixtures for Masonry Mortar	2.4.1.4	G												
			SD-05 Design Data														
			Masonry Compressive Strength	2.1.2	G												
			Fire-Rated Concrete Masonry Units	2.2.2.5													
			Bracing Calculations	3.2.5	G												
			SD-06 Test Reports														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / ACTION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		04 20 00	Fire-Rated Concrete Masonry Units	2.2.2.5													
			Field Testing of Mortar	3.6.1.1													
			Field Testing of Grout	3.6.1.2													
			Prism Tests	3.6.1.3													
			SD-07 Certificates														
			Special Masonry Inspector Qualifications	1.3.3													
			Concrete Masonry Units (CMU)	2.2.2.2													
			Precast Concrete Units	2.2.3													
			Cementitious Materials	2.4.1.1													
			Admixtures for Masonry Mortar	2.4.1.4													
			Admixtures for Grout	2.4.2.2													
			Anchors, Ties, and Bar Positioners	2.6.2													
			Joint Reinforcement	2.6.3													
			Insulation	2.6.7													
			SD-08 Manufacturer's Instructions														
			Admixtures for Masonry Mortar	2.4.1.4													
			Admixtures for Grout	2.4.2.2													
			SD-10 Operation and Maintenance Data														
			Take-Back Program	3.8													
			SD-11 Closeout Submittals														
			Recycled Content	2.2.2.2.2	S												
		05 12 00	SD-01 Preconstruction Submittals														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REV W/R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 12 00	Erection and Erection Bracing Drawings	1.4.1.1	G AE												
			SD-02 Shop Drawings														
			Fabrication Drawings	1.4.2	G AE												
			SD-03 Product Data														
			Shop Primer	2.6.2													
			Welding Electrodes and Rods	2.4.1													
			Direct Tension Indicator Washers	2.3.2.3													
			Non-Shrink Grout	2.4.2													
			Tension Control Bolts	2.3.3													
			Recycled Content for Structural Steel	2.2.1	S												
			Recycled Content for Structural Steel Tubing	2.2.2	S												
			Recycled Content for Steel Pipe	2.2.3	S												
			SD-05 Design Data														
			Shoring and Temporary Bracing	1.4.2	G AE												
			SD-06 Test Reports														
			Class B Coating	2.6.2													
			Bolts, Nuts, and Washers	2.3													
			Weld Inspection Reports	3.7.1.2													
			Direct Tension Indicator Washer	3.7.2.1													
			Inspection Reports														
			Bolt Testing Reports	3.7.3.1													
			SD-07 Certificates														
			Steel	2.2													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / ACTION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 12 00	Bolts, Nuts, and Washers	2.3													
			Galvanizing	2.5													
			AISC Structural Steel Fabricator	1.3													
			Quality Certification														
			AISC Structural Steel Erector	1.3													
			Quality Certification														
			Welding Procedures and	1.4.3.1													
			Qualifications														
			Welding Electrodes and Rods	2.4.1													
			Certified Welding Inspector	3.7.1.1													
			NDT Technician	3.7.1.2													
			Welding Procedure Specifications	3.4													
			(WPS)														
		05 30 00	SD-02 Shop Drawings														
			Fabrication Drawings	1.3.4	G AE												
			SD-03 Product Data														
			Accessories	2.2													
			Deck Units	2.1													
			Galvanizing Repair Paint	2.1.5													
			Touch-Up Paint	2.1.5													
			Welding Equipment	1.3.2													
			Welding Rods and Accessories	1.3.2													
			Recycled Content of Steel Deck	2.1	S												
			SD-04 Samples														
			Metal Roof Deck Units	2.1.1													
			Flexible Closure Strips	2.2.4													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	CLASSIFICATION GOVT CLASS S I F I C A T I O N A / E R E V I W N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 30 00	SD-05 Design Data														
			Deck Units	2.1	G AE												
			SD-07 Certificates														
			Welder Qualifications	1.3.2													
			Welding Procedures	1.3.2													
			Fire Safety	1.3.3.1													
			Wind Storm Resistance	1.3.3.2													
			Manufacturer's Certificate	1.3.1													
			Stud Manufacture's Certification	2.2.11													
			Stud Manufacture's Test Reports	2.2.11													
		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 Metal	2.1	S												
			Framing														
			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														
			Floor Gratings	2.4	G												
			Bollards	2.5	G												
			Angles and Plates	2.7	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH #	GOVT CLASS S I F I C A T I O N A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 50 13	Roof Hatches	2.8	G												
			Metal Canopies	2.9													
			SD-03 Product Data														
			Metal Canopies	2.9													
			Floor Gratings	2.4	G												
			Roof Hatches	2.8	G												
			Downspout Terminations	2.6	G												
			Recycled Content	2.1	S												
			SD-04 Samples														
			Metal Canopies	2.9	G												
			Certificates of Compliance	2.1	G												
			Certified Mill	2.2	G												
		05 51 00	SD-02 Shop Drawings														
			Iron and Steel Hardware	2.1	G												
			Steel Shapes, Plates, Bars, and Strips	2.1	G												
			Metal Stair System	2.2.1	G AE												
			SD-03 Product Data														
			Structural Steel Plates, Shapes, and Bars	2.4.1	G												
			Structural Steel Tubing	2.4.2	G												
			Hot-Rolled Carbon Steel Sheets and Strips	2.4.5	G												
			Cold-Finished Steel Bars	2.4.4	G												
			Hot-Rolled Carbon Steel Bars	2.4.3	G												
			Cold-Rolled Carbon Steel Sheets	2.4.6	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 51 00	Galvanized Carbon Steel Sheets	2.4.7	G												
			Cold-Drawn Steel Tubing	2.4.8	G												
			Concrete Inserts	2.3.3	G												
			Masonry Anchorage Devices	2.3.4	G												
			Protective Coating	2.2.3	G												
			Steel Pan Stairs	2.2.2	G AE												
			Steel Stairs	2.3.1	G AE												
			Recycled Content for Steel	2.3.1.2	S												
			SD-07 Certificates														
			Welding Procedures	1.3.1	G												
			Welder Qualification	1.3.1	G												
			Certification Letter from	1.3.3.1	G												
			Contractor's Professional Engineer														
			SD-08 Manufacturer's Instructions														
			Structural Steel Plates, Shapes, and Bars	2.4.1	G												
			Structural Steel Tubing	2.4.2	G												
			Galvanized Carbon Steel Sheets	2.4.7	G												
			Protective Coating	2.2.3	G												
			Masonry Anchorage Devices	2.3.4	G												
			Masonry Anchorage Devices	2.3.4	G												
		05 51 33	SD-02 Shop Drawings														
			Ladders	2.3													
			SD-03 Product Data														
			Ladders	2.3													
			SD-07 Certificates														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REVIEW R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 51 33	Fabricator Certification for 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												
			Steel Shapes, Plates, Bars and Strips	3.2	G												
			SD-03 Product Data														
			Structural Steel Plates, Shapes And Bars	2.2.1	G												
			Structural-Steel Tubing	2.2.2	G												
			Concrete Inserts	2.2.4	G												
			Masonry Anchorage Devices	2.2.5	G												
			Protective Coating	2.1.2	G												
			Steel Railings, Guardrails and Handrails	2.2.7	G												
			Anchorage and Fastening Systems	1.2.1	G												
			Recycled Content for Steel Railings	2.1.1	S												
			SD-07 Certificates														
			Welding Procedures	1.4.1	G												
			Welder Qualification	1.4.2	G												
			Certification Letter from Contractor's Professional Engineer	1.4.4.1	G												
			SD-08 Manufacturer's Instructions														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REV W/R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		05 52 00	Installation Instructions	3.2													
		06 10 00	SD-02 Shop Drawings														
			Nailing Strips	2.2.1	G												
			SD-03 Product Data														
			Fire-retardant Treatment	1.8													
			Adhesives	2.4.3													
			SD-06 Test Reports														
			Preservative-treated	1.4.3													
			SD-07 Certificates														
			Indoor Air Quality for Composite Wood	1.10.3.2	S												
			Certificates of Grade	1.10.1													
			Certified Sustainably Harvested Virgin Lumber	2.1.1	S												
			Certified Sustainably Harvested Framing Lumber	2.2.1	S												
			Certified Sustainably Harvested Plywood for Other Uses	2.3.1.1	S												
			Preservative Treatment	1.7													
			Indoor Air Quality for Adhesives and Sealants	1.10.3.1	S												
		06 41 16.00 10	SD-02 Shop Drawings														
			Shop Drawings	2.9													
			Installation	3.1													
			SD-03 Product Data														
			Wood Materials	2.1													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		06 41 16.00 10	Finish Schedule	1.2													
			Recycled Content for Medium Density Fiberboard	2.1.2.3	S												
			Recycled Content for Particleboard	2.1.2.2	S												
			Biobased Content for Panel Substrate	2.1.2.2	S												
			SD-04 Samples														
			Plastic Laminates	2.3													
			Cabinet Hardware	2.6													
			SD-07 Certificates														
			Quality Assurance	1.5													
			Laminate Clad Casework	3.1													
			Certified Sustainably Harvested Wood	1.5.3	S												
			Certified Sustainably Harvested Wood	1.5.3	S												
			Indoor Air Quality for Particleboard	1.5.2	S												
			Indoor Air Quality for Medium Density Fiberboard	1.5.2	S												
			Indoor Air Quality for Hardwood Plywood	1.5.2	S												
			Indoor Air Quality for Panel Substrate	1.5.2	S												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REVIEW WR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		06 41 16.00 10	Indoor Air Quality for Adhesives and Sealants	1.5.2	S												
		06 61 16	SD-02 Shop Drawings														
			Detail Fabrication Drawings	2.1	G												
			Installation	3.1	G												
			SD-03 Product Data														
			Solid Polymer	2.1.1	G												
			Indoor air quality for solid surface seam and sealant products	2.2.2	S												
			Recycled Content for Solid Surfacing Materials	2.1.1	S												
			SD-04 Samples														
			Material	2.1	G												
			Counter Tops	2.3.6	G												
			SD-06 Test Reports														
			Test Report Results	2.1.1													
			SD-07 Certificates														
			Qualifications	1.5.1													
			Indoor Air Quality for solid surface fabrication products	2.1.1	S												
			Indoor Air Quality for Solid Surfacing Materials	1.4.1	S												
			Indoor Air Quality for Solid Surface Seam Adhesive and Sealants	1.4.1	S												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		06 61 16	SD-10 Operation and Maintenance Data														
			Solid Polymer	2.1.1	G												
		07 05 23	SD-01 Preconstruction Submittals Work Plan	1.4	G												
			SD-03 Product Data Thermal Imaging Camera	2.2	G												
			SD-05 Design Data Envelope Surface Area Calculations	3.2	G												
			SD-07 Certificates Pressure Test Agency	1.6.2.1													
			Thermographer Qualifications	1.6.2.2													
			Test Instruments	1.6.3													
			Date Of Last Calibration	1.6.3													
			SD-06 Test Reports Pressure Test Procedures	3.5	G												
			Air Leakage Test Report	1.6.4	G												
			Air Leakage Test Report	3.5.8	G												
			Diagnostic Test Report	1.6.4	G												
			Diagnostic Test Report	3.6.5	G												
		07 13 53	SD-03 Product Data Manufacturer's Standard Details	1.3	G												
			Elastomeric Waterproofing Sheet Material	2.2	G												
			Protection Board	2.5	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 13 53	Primers, Adhesives, and Mastics	1.4	G												
			Primers, Adhesives, and Mastics	2.2	G												
			Protective Coverings	1.4	G												
			Protective Coverings	3.8	G												
			SD-06 Test Reports														
			Elastomeric Waterproofing Sheet	2.2	G												
			Material														
			Field Quality Control	3.7	G												
			SD-07 Certificates														
			Elastomeric Waterproofing Sheet	2.2													
			Material														
			Primers, Adhesives, and Mastics	1.4	G												
			Primers, Adhesives, and Mastics	2.2	G												
			Protective Coverings	1.4	G												
			Protective Coverings	3.8	G												
			Special Warranties	1.8	G												
			Special Warranties	1.8	G												
			Certificates Of Compliance	2.1.1	G												
			Certificates Of Compliance	2.1.2	G												
			SD-08 Manufacturer's Instructions														
			Primers, Adhesives, and Mastics	1.4	G												
			Primers, Adhesives, and Mastics	2.2	G												
			SD-11 Closeout Submittals														
			Certificates Of Compliance	2.1.1	G												
			Certificates Of Compliance	2.1.2	G												
		07 21 13	SD-03 Product Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CAT ION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 21 13	Manufacturer's Standard Details	1.3	G												
			Block or Board Insulation	2.1	G												
			Pressure Sensitive Tape	2.3	G												
			Protection Board or Coatings	1.4	G												
			Accessories	2.5	G												
			Recycled Content for Block or Board Insulation	2.1.5	S												
			SD-07 Certificates														
			Block or Board Insulation	2.1	G												
			Vapor Retarder	2.2	G												
			Protection Board or Coating	2.4	G												
			Protection Board or Coating	3.4.5	G												
			Special Warranties	1.8	G												
			Special Warranties	1.8	G												
			Indoor Air Quality For Block Or Board Insulation	1.5.1	S												
			Indoor Air Quality For Block Or Board Insulation	2.1.6	S												
			Indoor Air Quality for Adhesive	1.5.1	S												
			SD-08 Manufacturer's Instructions														
			Block or Board Insulation	2.1													
			Adhesive	2.5.1													
		07 21 16	SD-03 Product Data														
			Blanket Insulation	2.1													
			Recycled Content for Insulation Materials	2.1.2	S												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 21 16	Vapor Retarder	3.3.2													
			Pressure Sensitive Tape	3.3.2													
			Accessories	2.3													
			SD-07 Certificates														
			Indoor Air Quality for Insulation	2.1.4	S												
			Materials														
			Indoor Air Quality for Adhesives	2.3.1	S												
			SD-08 Manufacturer's Instructions														
			Insulation	3.3.1													
		07 22 00	SD-02 Shop Drawings														
			Insulation Board Layout	1.3	G												
			Verification of Existing Conditions	1.3	G												
			SD-03 Product Data														
			Insulation	2.1	G												
			Cover Board	1.4	G												
			Fasteners	2.3	G												
			Recycled Content For Insulation	2.1.2	S												
			SD-06 Test Reports														
			Flame Spread Rating	1.8.1	G												
			SD-07 Certificates														
			Installer Qualifications	1.6	G												
			SD-08 Manufacturer's Instructions														
			Fasteners	2.3	G												
			Insulation	2.1	G												
		07 27 10.00 10	SD-02 Shop Drawings														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 27 10.00 10	Air Barrier System Shop Drawings	2.1	G												
			SD-03 Product Data														
			Air Barrier System Product Data	2.1	G												
			SD-04 Samples														
			Material Samples For Air Barrier System	2.1	G												
			SD-05 Design Data														
			Design Data And Calculations For The Air Barrier System	1.8	G												
			SD-06 Test Reports														
			Design Review Report	1.8	G												
			Testing and Inspection	3.1.2	G												
			SD-07 Certificates														
			Air Barrier Inspector	1.7	G RO												
		07 27 19.01	SD-01 Preconstruction Submittals														
			Qualifications of Manufacturer	1.8.1	G												
			Qualifications of Installer	1.8.2	G												
			SD-02 Shop Drawings														
			Self-adhering Air Barrier	1.4	G												
			SD-03 Product Data														
			Self-adhering Air Barrier	1.4	G												
			Primers, Adhesives, and Mastics	2.2	G												
			Safety Data Sheets	1.4.2	G												
			SD-06 Test Reports														
			Field Peel Adhesion Test	1.6	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS OR A/E REVIEW OR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 27 19.01	Flame Propagation of Wall Assemblies	1.4.4	G												
			Flame Spread and Smoke Developed Index Ratings	1.4.4	G												
			Site Inspections and Testing	3.4.1	G												
			SD-07 Certificates														
			Self-adhering Air Barrier	1.4	G												
			SD-08 Manufacturer's Instructions														
			Self-adhering Air Barrier	1.4	G												
			Primers, Adhesives, and Mastics	2.2	G												
		07 27 26	SD-01 Preconstruction Submittals														
			Qualifications of Manufacturer	1.10.1	G												
			Qualifications of Installer	1.10.2	G												
			SD-02 Shop Drawings														
			Fluid-Applied Membrane Air Barrier	1.5	G												
			SD-03 Product Data														
			Fluid-Applied Membrane Air Barrier	1.5	G												
			Transition Membrane	2.3	G												
			Primers, Adhesives, and Mastics	2.2	G												
			Reinforcement	2.6	G												
			Safety Data Sheets	1.5.2	G												
			SD-04 Samples														
			Mockup	1.5.3	G												
			SD-06 Test Reports														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION REVIEW WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 27 26	Capillary Moisture Test	1.7	G												
			Field Peel Adhesion Test	1.5.4	G												
			Flame Propagation of Wall Assemblies	1.5.4	G												
			Flame Spread and Smoke Developed Index Ratings	1.5.4	G												
			Site Inspections	3.4.1	G												
			SD-07 Certificates														
			Fluid-Applied Membrane Air Barrier	1.5	G												
			Transition Membrane	2.3	G												
			Indoor Air Quality for Fluid-Applied Air Barrier	1.4.1	S												
			Indoor Air Quality for Primer and Mastic	1.4.1	S												
			Indoor Air Quality for Adhesive and Sealant	1.4.1	S												
			SD-08 Manufacturer's Instructions														
			Fluid-Applied Membrane Air Barrier	1.5	G												
			Transition Membrane	2.3	G												
			Primers, Adhesives, and Mastics	2.2	G												
		07 54 23	SD-02 Shop Drawings														
			Detail Drawings	1.6	G												
			Roof Plan	1.6	G												
			SD-03 Product Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REVIEW WR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 54 23	TPO Roofing Membrane	3.2.2	G												
			Recycled Content for TPO	2.2	S												
			Energy Star Label for roof	2.1.2	S												
			membrane														
			Heat Island Reduction	2.1.3	S												
			Bonding Adhesive	2.1.4													
			Flashing	1.5.4													
			Flashing	3.2.2.2													
			Membrane Fasteners and Plates	2.1.7													
			Roof Insulation	2.1.10													
			Recycled Content for Insulation	2.1.10	S												
			Pre-Manufactured Accessories	2.1.8													
			Water Cutoffs	3.6.1													
			Information Card	2.1.1													
			SD-05 Design Data														
			Wind Uplift Resistance	1.3.3	G												
			Fall Restraint System	2.3	G												
			SD-07 Certificates														
			Qualification of Manufacturer	1.5.1													
			Qualifications of Applicator	1.5.2													
			Qualification of Engineer of	1.5.3													
			Record														
			Wind Uplift Resistance	1.3.3													
			Fire Resistance	1.3.2													
			Minimum Polymer Thickness	2.1.1													
			Minimum Polymer Thickness	2.1.6													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 54 23	Sample	1.10	G												
			SD-08 Manufacturer's Instructions														
			Application Method	3.2	G												
			Membrane Flashing	2.1.6	G												
			Membrane Flashing	3.3.2	G												
			Perimeter Attachment	3.2.4													
			Auxiliary Fasteners	2.1.7.2													
			Pre-Manufactured Accessories	2.1.8													
			Cold Weather	1.8	G												
			SD-11 Closeout Submittals														
			Warranty	1.10	G												
			Information Card	2.1.1	G												
			Instructions to Government	3.10	G												
			Personnel														
		07 60 00	SD-02 Shop Drawings														
			Exposed Sheet Metal	2.2.1	G												
			Conductor Heads	3.1.16	G												
			Conductor Heads	3.1.16	G												
			Downspouts	3.1.14	G												
			Gravel Stops and fascia	2.2.1	G												
			Splash Pans	3.1.17	G												
			Base Flashing	3.1.10	G												
			Counterflashing	3.1.11	G												
			Flashing at Roof Penetrations	3.1.19	G												
			and Equipment Supports														
			Reglets	3.1.11	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 60 00	Scuppers	3.1.15	G												
			Copings	3.1.21	G												
			Recycled Content	2.1	S												
			SD-04 Samples														
			Finish Samples	1.4.2	G												
			SD-08 Manufacturer's Instructions														
			Instructions for Installation	1.4.3	G												
			Quality Control Plan	3.5	G												
			SD-10 Operation and Maintenance														
			Data														
			Cleaning and Maintenance	1.4.3	G												
		07 81 00	SD-03 Product Data														
			Fireproofing Material	3.3	G												
			SD-04 Samples														
			Spray-Applied Fireproofing	2.1	G												
			SD-06 Test Reports														
			Fire Resistance Rating	1.2.2	G												
			Field Tests	3.6	G												
			Evaluation Reports	1.2.3	G												
			SD-07 Certificates														
			Installer Qualifications	1.4.1	G												
			Surface Preparation Report	3.1	G												
			Manufacturer's Inspection Report	3.5.2	G												
		07 84 00	SD-02 Shop Drawings														
			Firestopping System	2.1	G												
			SD-03 Product Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		07 84 00	Firestopping Materials	2.2	G												
			SD-06 Test Reports														
			Inspection	3.3	G												
			SD-07 Certificates														
			Inspector Qualifications	1.5.2													
			Firestopping Materials	2.2													
			Installer Qualifications	1.5.1	G												
		07 92 00	SD-03 Product Data														
			Sealants	2.1	G												
			Primers	2.2	G												
			Bond Breakers	2.3	G												
			Backstops	2.4	G												
			Field Adhesion	3.1	G												
			SD-07 Certificates														
			Indoor Air Quality For Interior	2.1.1	S												
			Sealants														
			Indoor Air Quality For Interior	2.1.3	S												
			Floor Joint Sealants														
			Indoor Air Quality For Interior	2.1.4	S												
			Acoustical Sealants														
			Indoor Air Quality For Interior	2.5	S												
			Caulking														
		08 11 13	SD-02 Shop Drawings														
			Doors	2.1	G												
			Doors	2.1	G												
			Frames	2.6	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REV W/R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 11 13	Frames	2.6	G												
			Accessories	2.4													
			SD-03 Product Data														
			Doors	2.1	G												
			Recycled Content for Steel Door Product	2.1	S												
			Frames	2.6	G												
			Recycled Content for Steel Frame Product	2.6	S												
			Accessories	2.4													
			SD-04 Samples														
			Factory-applied Enamel Finish	2.10.4	G												
		08 11 16	SD-02 Shop Drawings														
			Door and Frame Assembly	1.5.1	G												
			SD-03 Product Data														
			Door and Frame Assembly	1.5.1	G												
			Recycled Content of Aluminum Material	2.2.3	S												
			SD-04 Samples														
			Finish Samples	1.5.2	G												
			SD-05 Design Data														
			Calculations	1.2.1	G												
			Air Infiltration	1.2.2	G												
			Water Penetration	1.2.3	G												
			NFRC Project Label Certificates for Fenestration	1.2.4	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I O W N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 11 16	SD-08 Manufacturer's Instructions														
			Door and Frame Assembly	1.5.1	G												
			Adjustments, Cleaning, and	1.5.3	G												
			Maintenance														
			NFRC Project Label Certificates	1.2.4	G												
			for Fenestration														
		08 14 00	SD-02 Shop Drawings														
			Doors	2.1	G												
			SD-03 Product Data														
			Doors	2.1	G												
			Recycled Content for Door Cores	2.1.2.1	S												
			Accessories	2.2													
			Water-resistant Sealer	2.3.7													
			Warranty	1.5													
			Sound Transmission Class	2.1.3	G												
			Rating														
			Fire Resistance Rating	2.1.4	G												
			SD-04 Samples														
			Doors	2.1													
			Door Finish Colors	2.3.6.3	G												
			SD-06 Test Reports														
			Cycle-Slam	2.4													
			Hinge Loading Resistance	2.4													
			SD-07 Certificates														
			Certificates of Grade	1.3.1													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION REVIEW OR A/E	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 14 00	Certified Sustainably Harvested	2.1.1	S												
			Stile and Rail Wood Doors														
			Certified Sustainably Harvested	2.1.2	S												
			Flush Wood Doors														
			Indoor Air Quality for	2.1.2.1	S												
			Particleboard and Agrifiber Door														
			Cores														
			SD-11 Closeout Submittals														
			Warranty	1.5													
		08 31 00	SD-02 Shop Drawings														
			Access Doors And Panels	1.3	G												
			SD-03 Product Data														
			Access Doors And Panels	1.3	G												
			Hardware	1.3.2	G												
			Accessories	2.2.8	G												
			Power Transfer Components	1.3.1	G												
			Recycled Content	2.1	S												
			SD-04 Samples														
			Finishes	2.5	G												
			SD-06 Test Reports														
			Fire-rating(s) of Assemblies	1.3.1	G												
			Acoustical Ratings of Assemblies	1.3.1	G												
		08 34 73	SD-02 Shop Drawings														
			Fabrication Drawings	2.1													
			SD-03 Product Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 34 73	Hollow Metal Sound Retardant Doors	2.1	G												
			Wood Sound Retardant Doors	2.1	G												
			Door Frames	2.1	G												
			Door Hardware	2.1	G												
			Door Frame Sound Infill	2.3.2	G												
			Intumescent Seals and Gasketing	2.1	G												
			Thresholds	2.1	G												
			Astragals	2.1	G												
			SD-06 Test Reports														
			Wind Loading Tests	2.4.4	G												
			Water Leakage Tests	2.4.4	G												
			Acoustical Tests	2.4.4	G												
			Air Infiltration Tests	2.4.4	G												
			Positive Pressure Tests	2.4.4	G												
			SD-07 Certificates														
			Hollow Metal Sound Retardant Doors	2.1	G												
			Indoor Air Quality for Doors	1.3.1.1	S												
			Wood Sound Retardant Doors	2.1	G												
			Door Frames	2.1	G												
			Door Hardware	2.1	G												
			Intumescent Seals,Gasketing and Door Bottoms	1.4.1.3	G												
			Thresholds	2.1	G												
			Astragals	2.1	G												

SUBMITTAL REGISTER												CONTRACT NO.					
TITLE AND LOCATION						CONTRACTOR											
Joint Cryptologic Center Building - Buckley SFB, CO																	
ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 34 73	Assembly Test Reports	3.3.1													
		08 41 13	SD-01 Preconstruction Submittals														
			Sample Warranty	1.2.1	G												
			List of Product Installations	1.2.1	G												
			SD-02 Shop Drawings														
			Installation Drawings	3.3	G												
			Fabrication Drawings	2.2	G												
			SD-03 Product Data														
			Manufacturer's Catalog Data	1.2.1	G												
			Finish	2.2.3	G												
			Recycled Content of Aluminum Material	2.1.1.2	S												
			SD-04 Samples														
			Finish and Color Samples	1.2.1	G												
			SD-06 Test Reports														
			Certified Test Reports	1.2.1	G												
			Deflection	3.4.2													
			Condensation Resistance and Thermal Transmittance	1.2.1													
			Water Infiltration	1.2.1													
			SD-07 Certificates														
			Indoor Air Quality For Sealants	1.4.1	S												
			SD-08 Manufacturer's Instructions														
			Manufacturer's Instructions	3.3													
			SD-11 Closeout Submittals														
			Manufacturer's Product Warranty	3.6													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 44 00	SD-02 Shop Drawings														
			Glazed Curtain Wall System	1.6	G												
			Installation Drawings	1.6													
			Shop-Painting Aluminum	2.4.2	G												
			Shop-Painting Steel	2.4.3	G												
			SD-03 Product Data														
			Glazed Curtain Wall System	1.6	G												
			Metals For Fabrication	2.2	G												
			Nonskinning Sealing Compound	2.3	G												
			Metal Accessories	2.4.1	G												
			Curtain-Wall Framing Members	2.5	G												
			Aluminum Doors and Frames	2.6	G												
			Thermal Insulation Materials	2.9	G												
			Masonry Anchorage Devices	2.11.4	G												
			Recycled Content of Aluminum	2.1.1	S												
			Doors and Frames														
			Recycled Content of Aluminum	2.1.1	S												
			Curtain-Wall Framing Members														
			Recycled Content of Aluminum	2.1.1	S												
			Windows														
			Warranties	1.8.1	G												
			SD-05 Design Data														
			Pigmented Organic Coating	2.4.5	G												
			Structural Calculations for	1.4.4.1	G												
			Deflection														
			SD-06 Test Reports														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REVIEW R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 44 00	Factory Test Results	1.4.4	G												
			Field Water Spray Test Results	1.5.1	G												
			Air Infiltration Test Results	1.5.2	G												
			Water Penetration Test Results	1.5.2.1	G												
			SD-07 Certificates														
			Energy Performance Certificates	1.4.4.6	G												
			Qualifications for the Curtain-Wall Installer	1.4.2	G												
			Indoor Air Quality for Sealants	1.3.1	S												
			SD-08 Manufacturer's Instructions														
			Glazed Curtain Wall System	1.6	G												
			Insulating Glass	3.3.13	G												
			Preventive Maintenance and Inspection	3.6.2	G												
			SD-11 Closeout Submittals														
			Warranty	1.8	G												
		08 71 00	SD-02 Shop Drawings														
			Hardware Devices	2.6													
			Hardware Schedule	1.3.7	G												
			Hardware Schedule	1.4	G												
			Hardware Schedule	1.4	G												
			Hardware Schedule	3.1	G												
			Keying System	2.6	G												
			Keying System	2.6	G												
			Wiring Diagram	2.6	G												
			Wiring Diagram	2.6	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 71 00	SD-03 Product Data														
			Hardware and Accessories	2.3	G												
			SD-08 Manufacturer's Instructions														
			Installation	1.6.1													
			SD-10 Operation and Maintenance														
			Data														
			Hardware Schedule	1.3.7	G												
			Hardware Schedule	1.4	G												
			Hardware Schedule	1.4	G												
			Hardware Schedule	3.1	G												
			SD-11 Closeout Submittals														
			Key Bitting	1.5.1													
			Warranty	1.7	G												
		08 81 00	SD-03 Product Data														
			Insulating Glass	2.3													
			Glazing Accessories	1.3													
			Sealants	2.4.3.1													
			SD-04 Samples														
			Insulating Glass	2.3													
			Glazing Compound	2.4.2													
			Tape	2.4.5													
			Sealing Tapes	2.4.5													
			SD-07 Certificates														
			Insulating Glass	2.3													
			Indoor Air Quality for Mastics and	1.6	S												
			Sealants														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		08 81 00	SD-08 Manufacturer's Instructions														
			Setting and Sealing Materials	2.4													
			Glass Setting	3.2													
			SD-11 Closeout Submittals														
			Insulated Glass Units	1.8.1													
			Monolithic Reflective Glass	1.8.2													
			Monolithic Opacified Spandrel	1.8.3													
		08 91 00	SD-02 Shop Drawings														
			Wall Louvers	1.4													
			SD-03 Product Data														
			Metal Wall Louvers	2.2													
			Door Louvers	2.3													
			SD-04 Samples														
			Wall Louver Samples	1.5	G												
			Door Louver Samples	1.5	G												
		09 22 00	SD-03 Product Data														
			Metal Support Systems	2.1													
			Recycled Content for Metal	2.1	S												
			Support Systems														
		09 29 00	SD-03 Product Data														
			Glass Mat Water-Resistant	2.1.3													
			Gypsum Tile Backing Board														
			Water-Resistant Gypsum Backing	2.1.2													
			Board														
			Accessories	2.1.9													
			Gypsum Board	2.1.1													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 29 00	Recycled Content for Gypsum Board	2.1.1	S												
			Recycled Content for Paper Facing and Gypsum Cores	2.1.1	S												
			VOC Content of Joint Compound	2.1.5	S												
			SD-07 Certificates														
			Asbestos Free Materials	2.1	G												
			Indoor Air Quality for Gypsum Board	2.1.1	S												
			Indoor Air Quality for Adhesives and Sealants	1.3.1.2	S												
			Indoor Air Quality for Adhesives and Sealants	2.1.7	S												
			Indoor Air Quality for Joint Compound	1.3.1.1	S												
			SD-08 Manufacturer's Instructions														
			Safety Data Sheets	2.1													
			SD-10 Operation and Maintenance Data														
			Manufacturer Maintenance Instructions	2.1													
		09 30 10	SD-02 Shop Drawings														
			Detail Drawings	3.2	G AE												
			SD-03 Product Data														
			Porcelain Tile	2.1.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 30 10	Recycled Content for Porcelain Tile	2.1.1	S												
			Glazed Ceramic Wall Tile	2.1.2	G												
			Recycled Content for Glazed Ceramic Wall Tile	2.1.2	S												
			Transition Strips	2.1	G												
			Transition Strips	2.6.1	G												
			Setting-Bed	2.2	G												
			Mortar, Grout, and Adhesive	2.4	G												
			Cementitious Backer Units	2.5.1	G												
			Glass-Mat Gypsum	2.5.2	G												
			Water-Resistant Backing Board														
			Waterproof Membrane	2.7	G												
			Crack Isolation Membrane	2.8	G												
			SD-04 Samples														
			Tile	2.1	G												
			Accessories	2.1	G												
			Transition Strips	2.1	G												
			Transition Strips	2.6.1	G												
			Grout	2.4.4	G												
			SD-07 Certificates														
			Indoor Air Quality for Adhesives	2.4	S												
			Indoor Air Quality for Sealants	2.4.9	S												
			Water Absorption Rates	1.3.2													
			Indoor Air Quality for Mortar and Grout	1.3.1.2	S												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I O W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 30 10	Indoor Air Quality for Cementitious Backer Units	1.3.1.1	S												
			Indoor Air Quality for Glass-Mat Gypsum Board	1.3.1.1	S												
			Indoor Air Quality for Primer and Sealer	1.3.1.3	S												
			Indoor Air Quality for Waterproofing Membrane and Crack Isolation Membrane	1.3.1.3	S												
			SD-08 Manufacturer's Instructions Manufacturer's Approved Cleaning Instructions	3.8													
			SD-10 Operation and Maintenance Data														
			Porcelain Tile	2.1.1	G												
			Glazed Ceramic Wall Tile	2.1.2	G												
			Transition Strips	2.1	G												
			Transition Strips	2.6.1	G												
		09 51 00	SD-02 Shop Drawings Approved Detail Drawings	2.1	G AE												
			SD-03 Product Data Acoustical Ceiling Systems	2.1.1	G AE												
			Fire Resistive Ceilings	2.1.1	G AE												
			Recycled Content for Type IV Ceiling Tiles	2.2.2.1	S												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 51 00	Recycled Content for Type XII Ceiling Tiles	2.2.1.1	S												
			Recycled Content for Suspension Systems	2.3	S												
			Acoustical Performance	2.1.2	G AE												
			SD-04 Samples														
			Acoustical Units	2.2	G												
			Acoustical Ceiling Tiles	2.2.1.1	G												
			Acoustical Ceiling Tiles	2.2.2.1	G												
			SD-06 Test Reports														
			Fire Resistive Ceilings	2.1.1	G												
			SD-07 Certificates														
			Indoor Air Quality for Type IV Ceiling Tiles	2.2.2.1	S												
			Indoor Air Quality for Type XII Ceiling Tiles	2.2.1.1	S												
			Indoor Air Quality for Adhesives	2.6	S												
			Indoor Air Quality for Sealants	2.9	S												
		09 62 38	SD-03 Product Data														
			Static-Control Resilient Flooring	2.1	G												
			Accessories	2.5	G												
			Adhesives	2.3	G												
			Warranty	1.9													
			SD-04 Samples														
			Static-Control Resilient Flooring	2.1	G												
			Moldings	2.4	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 62 38	Accessories	2.5	G												
			SD-06 Test Reports														
			Fire Resistance	2.8													
			Moisture, Alkalinity and Bond	3.2													
			Testing	3.7													
			SD-07 Certificates														
			Indoor Air Quality for	2.1.1.1	S												
			Static-Dissipative Vinyl Tile														
			Indoor Air Quality for Adhesives	2.3	S												
			Qualifications of Applicator	1.6													
			SD-08 Manufacturer's Instructions														
			Static-Control Resilient Flooring	2.1	G												
			Accessories	2.5	G												
			SD-10 Operation and Maintenance														
			Data														
			Static-Control Resilient Flooring	2.1	G												
			Accessories	2.5	G												
		09 65 00	SD-02 Shop Drawings														
			Resilient Flooring and	2.10	G												
			Accessories														
			SD-03 Product Data														
			Resilient Flooring and	2.10	G												
			Accessories														
			Adhesives	2.6	G												
			Recycled content for Wall Base	2.3	S												
			Luxury Vinyl Tile	2.2													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 65 00	Rubber Tile	2.1													
			Wall Base	2.3													
			Stair Treads and Risers	2.4													
			SD-04 Samples														
			Resilient Flooring and Accessories	2.10	G												
			SD-06 Test Reports														
			Moisture, Alkalinity and Bond Tests	3.3	G												
			SD-07 Certificates														
			Indoor Air Quality for Rubber Tile	1.3.1.1	S												
			Indoor Air Quality for Rubber Tile	2.1	S												
			Indoor Air Quality for Luxury Vinyl Tile	1.3.1.1	S												
			Indoor Air Quality for Luxury Vinyl Tile	2.2	S												
			Indoor Air Quality for Wall Base	1.3.1.1	S												
			Indoor Air Quality for Wall Base	2.3	S												
			Indoor Air Quality for Adhesives	1.3.1.2	S												
			Indoor Air Quality for Adhesives	2.6	S												
			SD-08 Manufacturer's Instructions														
			Surface Preparation	3.2	G												
			Installation	3.1	G												
			SD-10 Operation and Maintenance Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 65 00	Resilient Flooring and Accessories	2.10	G												
		09 68 00	SD-02 Shop Drawings														
			Installation Drawings	3.4	G												
			SD-03 Product Data														
			Carpet	2.1	G												
			Recycled Content for Carpeting	2.1.1	S												
			Moldings	2.4	G												
			Indoor Air Quality for Aerosol	2.3	S												
			Adhesives														
			Indoor Air Quality for Non-Aerosol	2.3	S												
			Adhesives														
			Indoor Air Quality for Concrete	2.3	S												
			Primer														
			SD-04 Samples														
			Carpet	2.1	G												
			Moldings	2.4	G												
			SD-06 Test Reports														
			Moisture and Alkalinity Tests	3.2	G												
			SD-07 Certificates														
			Indoor Air Quality for Carpet	1.3.1.1	S												
			Indoor Air Quality for Carpet	2.1.2	S												
			Indoor Air Quality for Adhesives	1.3.1.2	S												
			Indoor Air Quality for Concrete	1.3.1.3	S												
			Primer and Sealer														
			SD-08 Manufacturer's Instructions														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N A / E R E V I O W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 68 00	Surface Preparation	3.1													
			SD-10 Operation and Maintenance Data														
			Cleaning and Protection	3.5													
			SD-11 Closeout Submittals														
			Warranty	1.6													
		09 84 20	SD-02 Shop Drawings														
			Approved Detail Drawings	2.2	G AE												
			SD-03 Product Data														
			Installation	3.2	G AE												
			Acoustical Wall Panels	2.2	G AE												
			SD-04 Samples														
			Acoustical Wall Panels	2.2	G												
			SD-07 Certificates														
			Acoustical Wall Panels	2.2													
			Indoor Air Quality for Acoustic Wall Panels	1.3.2	S												
			SD-11 Closeout Submittals														
			Warranty	1.5													
		09 90 00	SD-02 Shop Drawings														
			Piping Identification	3.10													
			SD-03 Product Data														
			Coating	2.1	G												
			Product Data Sheets	2.1													
			SD-04 Samples														
			Color	2.2	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION REVIEW OR E	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		09 90 00	SD-07 Certificates														
			Qualification Testing	1.5.5.2	G												
			Indoor Air Quality for Paints and Primers	1.5.4	S												
			Indoor Air Quality for Consolidated Latex Paints	1.5.4	S												
			SD-08 Manufacturer's Instructions														
			Mixing	2.1													
			Manufacturer's Safety Data Sheets	1.7.1													
			SD-10 Operation and Maintenance Data														
			Coatings	2.1	G												
		10 14 00.10	SD-02 Shop Drawings														
			Approved Detail Drawings	3.1	G												
			SD-03 Product Data														
			Modular Exterior Signage System	2.1													
			Installation	3.1													
			Exterior Signage	1.2	G												
			Wind Load Requirements	1.2.1													
			SD-04 Samples														
			Exterior Signage	1.2	G												
			SD-10 Operation and Maintenance Data														
			Protection and Cleaning	3.1.2	G												
		10 14 00.20	SD-02 Shop Drawings														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N A / E R E V W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		10 14 00.20	Detail Drawings	1.4.2	G												
			SD-03 Product Data														
			Room Identification Sign	2.2	G												
			Exit Door Tactile Sign	2.3	G												
			Building Directories	2.4	G												
			Building Directories	2.4	G												
			SD-04 Samples														
			Interior Signage	1.4.1	G												
			Interior Signage	1.6	G												
			Software	1.3	G												
			Room Identification Sign	2.2	G												
			Exit Door Tactile Sign	2.3	G												
			Building Directories	2.4	G												
			Building Directories	2.4	G												
			SD-10 Operation and Maintenance														
			Data														
			Approved Manufacturer's	3.1	G												
			Instructions														
			Protection and Cleaning	3.1.2	G												
		10 21 13	SD-02 Shop Drawings														
			Fabrication Drawings	2.1													
			Installation Drawings	3.3	G												
			SD-03 Product Data														
			Cleaning and Maintenance	2.1													
			Instructions														
			Colors And Finishes	2.6													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		10 21 13	Sound-Deadening Cores	2.2.2													
			Anchoring Devices and Fasteners	2.2.3													
			Hardware and Fittings	2.2.5													
			Brackets	2.2.4													
			Door Hardware	2.2.6													
			Toilet Enclosures	2.3.1													
			Toilet Enclosures	2.3.1													
			Urinal Screens	2.3.2													
			Finishes	2.2.5.2	G												
			Finishes	2.6.2	G												
			Recycled content for stainless steel partitions and screens	2.3	S												
			SD-04 Samples														
			Colors and Finishes	2.6	G												
			Hardware and Fittings	2.2.5													
			Anchoring Devices and Fasteners	2.2.3													
			SD-07 Certificates														
			Warranty	1.5													
		10 21 23.16	SD-02 Shop Drawings														
			Cubicle Track Layout	1.3	G												
			SD-08 Manufacturer's Instructions														
			Installation	3.1													
			SD-10 Operation and Maintenance Data														
			Cubicle Track System	2.1	G												
		10 22 39	SD-02 Shop Drawings														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		10 22 39	Coordination Drawings	1.4.1	G												
			Layouts	3.1.1	G												
			Installation Drawings	3.1	G												
			SD-03 Product Data														
			Folding Panel Partitions	2.3	G												
			Recycled Content for Steel Components	2.3.1	S												
			Recycled Content for Aluminum Components	2.3.1	S												
			SD-04 Samples														
			Partition System Samples	2.6	G												
			SD-06 Test Reports														
			Acoustical Test Reports	2.1.2.1	G												
			Field Sound Test Reports	3.2.3.1													
			SD-07 Certificates														
			Indoor Air Quality for Finish Covering	1.3.1.1													
			Indoor Air Quality for Finish Covering	2.3.2													
			Installer Qualifications	1.4.2													
			Manufacturer's Qualifications	1.4.3													
			SD-08 Manufacturer's Instructions														
			Installation Instructions	3.1													
			SD-10 Operation and Maintenance Data														
			Folding Panel Partitions	2.3	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		10 26 00	SD-02 Shop Drawings														
			Corner Guards	2.2	G												
			SD-03 Product Data														
			Corner Guards	2.2	G												
			Recycled content for aluminum component of corner guards	2.2.1	S												
			SD-04 Samples														
			Corner Guards	2.2	G												
			SD-06 Test Reports														
			Fire Resistance Rating	2.1.1.2													
			SD-07 Certificates														
			Indoor air quality for adhesives	1.3.1.2	S												
			Indoor air quality for adhesives	2.4	S												
			SD-10 Operation and Maintenance Data														
			Corner Guards	2.2	G												
		10 28 13	SD-02 Shop Drawings														
			Product Schedule	2.1	G												
			SD-03 Product Data														
			Item A5080	2.1.3	G												
			Item A5083	2.1.4	G												
			Item A5084	2.1.5	G												
			Item A5085	2.1.6	G												
			Item A5090	2.1.7	G												
			Item A5091	2.1.8	G												
			Item A5095	2.1.9	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS OR A/E REVIEW OR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		10 28 13	Item A5110	2.1.10	G												
			Item A5135	2.1.11	G												
			Item A5145	2.1.12	G												
			Item A5176	2.1.13	G												
			Item A5177	2.1.14	G												
			Item A5200	2.1.15	G												
			Item A5200	2.1.15	G												
			Item A5201	2.1.16													
			Recycled content for stainless steel toilet accessories	2.1	S												
			Seat cover dispenser	2.1.17													
			SD-10 Operation and Maintenance Data														
			Item A5110	2.1.10	G												
			Item A5080	2.1.3	G												
			Item A5083	2.1.4	G												
			Item A5084	2.1.5	G												
			Item A5085	2.1.6	G												
			Item A5090	2.1.7	G												
			Item A5091	2.1.8	G												
			Item A5095	2.1.9	G												
			Item A5135	2.1.11	G												
			Item A5145	2.1.12	G												
			Item A5176	2.1.13	G												
			Item A5177	2.1.14	G												
			Item A5200	2.1.15	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS OR FIC ATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		10 28 13	Item A5200	2.1.15	G												
			Item A5201	2.1.16													
			Seat cover dispenser	2.1.17													
		10 44 16	SD-02 Shop Drawings														
			Fire Extinguishers	2.1.1	G												
			Accessories	Part 2	G												
			Cabinets	Part 2	G												
			Wall Brackets	2.2.2	G												
			Schedule	1.5	G												
			SD-03 Product Data														
			Fire Extinguishers	2.1.1	G												
			Accessories	Part 2	G												
			Cabinets	Part 2	G												
			Wall Brackets	2.2.2	G												
			Replacement Parts List	3.2.1	G												
			SD-04 Samples														
			Equipment Samples	1.3.1	G												
			SD-07 Certificates														
			Fire Extinguishers Certifications	2.1.1	G												
			Manufacturer's Warranty with	1.4	G												
			Inspection Tag														
		10 51 13	SD-02 Shop Drawings														
			Types	2.1	G												
			Location	1.4	G												
			Installation	3.1	G												
			Numbering system	3.2													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		10 51 13	SD-03 Product Data														
			Material	2.2	G												
			Locking Devices	2.3.1	G												
			Finish	2.2.2	G												
			components	2.3	G												
			Assembly	3.1	G												
			SD-04 Samples														
			Color chips	1.5.1	G												
		12 24 13	SD-02 Shop Drawings														
			Detailed Drawings	3.2	G												
			Location Schedule	2.1	G												
			SD-03 Product Data														
			Window Shades	2.1	G AE												
			Recycled Content for various fiber components	2.1	S												
			SD-04 Samples														
			Window Shades	2.1	G AE												
			SD-06 Test Reports														
			Flammability Requirements	1.4.2	G												
			SD-07 Certificates														
			Indoor Air Quality for roller window shades	2.1	S												
			Qualifications	1.4.1.1													
			SD-10 Operation and Maintenance Data														
			Window Shades	2.1													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		12 50 00.13 10	SD-01 Preconstruction Submittals														
			Storage Location	1.7.3	G												
			SD-02 Shop Drawings														
			Installation Drawings	3.3.1	G A/E												
			Grommet, Power and	3.3.1	G A/E												
			Communication Units, and Wire														
			Management Locations														
			SD-03 Product Data														
			Product Data	2.3	G A/E												
			Product Style Options	2.3	G A/E												
			SD-04 Samples														
			Fabric and Finishes	2.3.6	G A/E												
			SD-07 Certificates														
			Authorized Dealer	1.6	G												
			Certified Furniture Installers	1.6	G												
			Licensed Electrician	1.6	G												
			Certified Telecommunications	1.6	G												
			Installer														
			Manufacturer's Certification	2.3	G												
			Warranty	1.8	G												
			SD-10 Operation and Maintenance														
			Data														
			Furniture, Data Package 1	3.5	G A/E												
			SD-11 Closeout Submittals														
			Energy Efficient Equipment	2.1.1	S												
			Reduced VOC's for Furniture	2.1.2	S												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		12 50 00.13 10	Recycled Content of Furniture	2.1.3	S												
			Bio-Based Content of Furniture	2.1.4	S												
		12 59 00	SD-02 Shop Drawings														
			Detail Drawings	1.4.4	G AE												
			SD-03 Product Data														
			Warranty	1.6	G AE												
			Workstations	2.2.1	G AE												
			Power and Communications	2.11	G AE												
			Communications	2.11.7	G AE												
			Recycled Content for system furniture components	2.1	S												
			Energy Star Label for Task Lighting	2.11.6	S												
			SD-04 Samples														
			Workstations	2.2.1	G AE												
			Mock-up	2.2.3	G AE												
			Samples	2.2.2													
			SD-06 Test Reports														
			Selected Components	2.2.5.1	G AE												
			Panel Acoustics	2.2.5.2	G AE												
			Fire Safety	1.4.2	G AE												
			Electrical System	1.4.3	G												
			SD-07 Certificates														
			Workstations	2.2.1													
			Indoor Air Quality for Systems	1.3.2.1	S												
			Furniture and Seating														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		12 59 00	Certified Sustainably Harvested Wood Furniture	1.3.1	S												
			SD-10 Operation and Maintenance Data														
			Assembly Manuals	2.3.1	G AE												
			Maintenance Manuals	3.2	G AE												
			Cleaning	3.2	G AE												
			Electrical System	1.4.3	G AE												
			Installation	3.1	G												
		14 24 23	SD-02 Shop Drawings														
			Elevator	2.1	G AE												
			Elevator Components	1.2.1	G AE												
			Elevator Components	1.2.2	G AE												
			Elevator Machine	1.2.1	G AE												
			Elevator Controller	1.2.1	G AE												
			Wiring Diagrams	1.3.4	G AE												
			SD-03 Product Data														
			Elevator	2.1	G AE												
			Elevator Components	1.2.1	G AE												
			Elevator Components	1.2.2	G AE												
			Data Sheets	1.2.2	G AE												
			Elevator Microprocessor Controller	2.5.2	G AE												
			SD-05 Design Data														
			Emergency Power Systems	1.2.3.3													
			Heat Loads	1.2.3.2													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		14 24 23	Reaction Loads	1.2.3.1													
			SD-07 Certificates														
			Price Lists	1.3.2	G												
			Warranty	1.4													
			Endorsement Letter	1.3.1.1													
			Welders' Qualifications	1.2.4													
			Elevator Controller Certification	2.5.2.3	G												
			Indoor Air Quality for Flooring System	2.1.2	S												
			Indoor Air Quality for Adhesives	2.1.2	S												
			SD-10 Operation and Maintenance Data														
			Elevator	2.1	G												
			Maintenance Control Program (MCP)	1.2.5	G												
			Software and Documentation	2.5.2.2	G												
		21 13 13	SD-01 Preconstruction Submittals														
			Qualified Fire Protection Engineer (QFPE)	1.2.3	G												
			Sprinkler System Designer	1.4.2.1	G												
			Sprinkler System Installer	1.4.2.2	G												
			SD-02 Shop Drawings														
			Shop Drawing	1.2.1.1	G												
			SD-03 Product Data														
			Pipe	2.2.1	G												
			Fittings	2.3.1.2	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION OR REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		21 13 13	Valves	2.3.4	G												
			Riser check Valves	2.3.5	G												
			Relief Valves	2.8.5	G												
			Sprinklers	2.7	G												
			Pipe Hangers and Supports	2.3.3	G												
			Sprinkler Alarm Switch	2.4.1	G												
			Valve Supervisory (Tamper) Switch	2.4.2	G												
			Fire Department Connection	2.6	G												
			Backflow Prevention Assembly	2.5	G												
			Air Vent	2.8.6	G												
			Hose Valve	2.5.1	G												
			Seismic Bracing	2.3.3	G												
			Nameplates	2.1.2	G												
			SD-05 Design Data														
			Seismic Bracing	2.3.3	G												
			Hydraulic Calculations	1.2.1.2	G												
			SD-06 Test Reports														
			Test Procedures	3.7.1	G												
			SD-07 Certificates														
			Verification of Compliant Installation	3.7.2.1	G												
			Request for Government Final Test	3.7.2.2	G												
			SD-10 Operation and Maintenance Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REVIEW WR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		21 13 13	Operating and Maintenance (O&M) Instructions	3.9	G												
			Spare Parts	1.6	G												
			SD-11 Closeout Submittals														
			As-built drawings	3.9													
		22 00 00	SD-02 Shop Drawings														
			Plumbing System	3.9.1	G												
			SD-03 Product Data														
			Backflow Prevention Assemblies	3.9.1.1	G												
			Fixtures	2.4	S												
			Flush Valve Water Closets	2.4.3	G												
			WaterSense Label for Flush Valve Water Closet	2.4.3	S												
			Flush Valve Urinals	2.4.4	G												
			WaterSense Label for Urinal	2.4.4	S												
			Wall Hung Lavatories	2.4.6	G												
			Countertop Lavatories	2.4.7	G												
			Breakroom Sinks	2.4.8	G												
			Wheelchair Drinking-Water Coolers	2.4.9	G												
			Energy Star Label for Wheelchair Electric Water Cooler	2.4.9	S												
			Water Heaters	2.8	G												
			Electric Storage Water Heater	3.12.1.1	S												
			Pumps	2.9	G												
			Welding	1.5.1													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REV / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		22 00 00	Vibration-Absorbing Features	3.4	G												
			Plumbing System	3.9.1	G												
			SD-06 Test Reports														
			Tests, Flushing and Disinfection	3.9	G												
			Test of Backflow Prevention	3.9.1.1	G												
			Assemblies														
			SD-07 Certificates														
			Materials and Equipment	1.3	G												
			Bolts	2.1.1	G												
			SD-10 Operation and Maintenance														
			Data														
			Plumbing System	3.9.1	G												
		23 05 15	SD-01 Preconstruction Submittals														
			Material, Equipment, and Fixture	1.2	G												
			Lists														
			SD-02 Shop Drawings														
			Record Drawings	1.2	G												
			Connection Diagrams	1.2	G												
			Coordination Drawings	1.2	G												
			Fabrication Drawings	1.2	G												
			Installation Drawings	3.1	G												
			Water Temperature Mixing Valve	2.4.7	G												
			Water Temperature Regulating	2.4.8	G												
			Valves														
			Water Pressure Reducing Valve	2.4.9	G												
			Pressure Relief Valve	2.4.10	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 05 15	Combination Pressure and Temperature Relief Valves	2.4.11	G												
			SD-03 Product Data														
			Pipe and Fittings	2.2	G												
			Piping Specialties	2.3	G												
			Valves	2.4	G												
			Miscellaneous Materials	2.5	G												
			Supporting Elements	2.6	G												
			Equipment Foundation Data	1.2	G												
			Water Temperature Mixing Valve	2.4.7	G												
			Water Temperature Regulating Valves	2.4.8	G												
			Water Pressure Reducing Valve	2.4.9	G												
			Pressure Relief Valve	2.4.10	G												
			Combination Pressure and Temperature Relief Valves	2.4.11	G												
			SD-04 Samples														
			Manufacturer's Standard Color Charts	1.2	G												
			SD-05 Design Data														
			Pipe and Fittings	2.2	G												
			Piping Specialties	2.3	G												
			Valves	2.4	G												
			SD-06 Test Reports														
			Hydrostatic Tests	3.1	G												
			Air Tests	3.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 05 15	Valve-Operating Tests	3.1	G												
			Drainage Tests	3.1	G												
			Pneumatic Tests	3.1	G												
			Non-Destructive Electric Tests	3.1	G												
			System Operation Tests	3.1	G												
			SD-07 Certificates														
			Record of Satisfactory Field Operation	1.4.2	G												
			List of Qualified Permanent Service Organizations	1.4.3	G												
			Listing of Product Installations	1.2	G												
			Records of Existing Conditions	1.2	G												
			Surface Resistance	3.1	G												
			Shear and Tensile Strengths	3.1	G												
			Temperature Ratings	3.1	G												
			Bending Tests	3.1	G												
			Flattening Tests	3.1	G												
			Transverse Guided Weld Bend Tests	3.1	G												
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance Manuals	3.15	G												
			SD-11 Closeout Submittals														
			Water Temperature Mixing Valve	2.4.7	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 05 15	Water Temperature Regulating Valves	2.4.8	G												
			Water Pressure Reducing Valve	2.4.9	G												
			Pressure Relief Valve	2.4.10	G												
			Combination Pressure and Temperature Relief Valves	2.4.11	G												
		23 05 48.19	SD-02 Shop Drawings														
			Coupling and Bracing	3.1	G												
			Flexible Couplings or Joints	3.2	G												
			Equipment Restraint	2.2	G												
			Contractor Designed Bracing	1.2.2	G												
			SD-03 Product Data														
			Coupling and Bracing	3.1	G												
			Flexible Couplings Or Joints	3.2	G												
			Equipment Restraint	2.2	G												
			Contractor Designed Bracing	1.2.2	G												
			Anchor Bolts	3.7	G												
			Vibration Isolators	2.2.2	G												
			SD-05 Design Data														
			Design Calculations	1.2.2	G												
			SD-06 Test Reports														
			Anchor Bolts	3.7	G												
		23 05 93	SD-01 Preconstruction Submittals														
			Records of Existing Conditions	1.4.4	G												
			TAB Firm	1.6.3.1	G												
			TAB Team Assistants	1.3	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REV / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 05 93	TAB Team Engineer	1.3	G												
			TAB Specialist	1.6.3.2	G												
			TAB Team Field Leader	1.3	G												
			SD-02 Shop Drawings														
			TAB Schematic Drawings and Report Forms	1.4.4	G												
			SD-03 Product Data														
			Equipment and Performance Data	1.4	G												
			TAB Related HVAC Submittals	1.6.3.4	G												
			TAB Procedures	1.6.2	G												
			Calibration	1.6.2	G												
			Systems Readiness Check	1.4.4	G												
			TAB Execution	1.6.4	G												
			TAB Verification	1.6.4.3	G												
			SD-06 Test Reports														
			Completed Pre-Final DALT Report	3.3.5	G												
			Certified Final DALT Report	3.3.8	G												
			TAB Design Review Report	1.7.2.1	G												
			TAB Report for Season 1	1.6.5.2	G												
			TAB Report for Season 2	1.6.5.2	G												
			SD-07 Certificates														
			Independent TAB Agency and Personnel Qualifications	1.6.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 05 93	DALT and TAB Submittal and Work Schedule	1.7.2	G												
			TAB Pre-Field Engineering Report	1.7.2.3	G												
			TAB Firm	1.6.3.1	G												
			Design Review Report	1.4.4	G												
			Pre-field DALT Preliminary Notification	1.7.2.2	G												
			Advanced Notice for Season 1 TAB Field Work	1.7.2	G												
			Prerequisite HVAC Work Check Out List For Season 1	1.7.2	G												
			Advanced Notice for Season 2 TAB Field Work	1.7.2	G												
			Prerequisite HVAC Work Check Out List For Season 2	1.7.2	G												
		23 07 00	SD-02 Shop Drawings														
			MICA Plates	3.2.2.4	G												
			Pipe Insulation Systems	2.3	G												
			Pipe Insulation Systems	3.2	G												
			Duct Insulation Systems	3.3	G												
			Equipment Insulation Systems	3.4	G												
			Recycled content for insulation materials	2.3.1	S												
			SD-03 Product Data														
			Pipe Insulation Systems	2.3	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 07 00	Pipe Insulation Systems	3.2	G												
			Duct Insulation Systems	3.3	G												
			Equipment Insulation Systems	3.4	G												
			SD-04 Samples														
			Thermal Insulation	2.2.1.2	G												
			Display Samples	3.1.1	G												
			SD-07 Certificates														
			Indoor air quality for adhesives	2.2.1	S												
			SD-08 Manufacturer's Instructions														
			Pipe Insulation Systems	2.3	G												
			Pipe Insulation Systems	3.2	G												
			Duct Insulation Systems	3.3	G												
			Equipment Insulation Systems	3.4	G												
		23 09 00	SD-02 Shop Drawings														
			DDC Contractor Design Drawings	3.2	G AE												
			Draft As-Built Drawings	3.2	G AE												
			Final As-Built Drawings	3.2	G AE												
			SD-03 Product Data														
			Programming Software	1.8.3	G												
			Controller Application Programs	1.8.4	G												
			Configuration Software	1.8.1	G												
			Controller Configuration Settings	1.8.2	G												
			Manufacturer's Product Data	2.2	G												
			SD-06 Test Reports														
			Pre-Construction Quality Control (QC) Checklist	1.9.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 09 00	Post-Construction Quality Control (QC) Checklist	1.9.2	G												
			Start-Up Testing Report	3.4.2	G												
			PVT Procedures	3.5.1	G												
			PVT Report	3.5.3	G												
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance (O&M) Instructions	3.6	G												
			Training Documentation	3.8.1	G												
			SD-11 Closeout Submittals														
			Enclosure Keys	2.5	G												
			Closeout Quality Control (QC) Checklist	1.9.3	G												
		23 11 20	SD-02 Shop Drawings														
			Gas Piping System	1.5.3	G												
			Gas Piping System	2.2	G												
			Gas Piping System	3.3	G												
			SD-03 Product Data														
			Pipe and Fittings	1.6.1	G												
			Gas Equipment Connectors	1.5.3	G												
			Gas Piping System	1.5.3	G												
			Gas Piping System	2.2	G												
			Gas Piping System	3.3	G												
			Pipe Coating Materials	2.1	G												
			Pressure Regulators	2.6	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 11 20	Risers	2.4	G												
			Transition Fittings	2.2.10	G												
			Valves	2.3	G												
			Warning and Identification Tape	2.2.6	G												
			SD-06 Test Reports														
			Testing	3.18	G												
			Pressure Tests	3.18.1	G												
			Test with Gas	3.18.2	G												
			SD-07 Certificates														
			Welders Procedures and	1.5.1	G												
			Qualifications														
			Assigned Number, Letter, or	1.5.1	G												
			Symbol														
			SD-08 Manufacturer's Instructions														
			PE Pipe and Fittings	1.5.2	G												
			Pipe Coating Materials	2.1	G												
			SD-10 Operation and Maintenance														
			Data														
			Gas Facility System and	1.3.1	G												
			Equipment Operation														
			Gas Facility System Maintenance	1.3.2	G												
			Gas Facility Equipment	1.3.3	G												
			Maintenance														
		23 21 23	SD-02 Shop Drawings														
			System Coordination	2.1.2	G												
			SD-03 Product Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 21 23	Instructions	2.2.2	G												
			Equipment Data	2.2.5	G												
			Training Period	3.5.2	G												
			SD-06 Test Reports														
			Factory Tests	2.8	G												
			Field Quality Control	3.3	G												
			SD-07 Certificates														
			Manufacturer's Representative	1.4.1	G												
			SD-10 Operation and Maintenance														
			Data														
			Operation and Maintenance	3.5.1	G												
			Manuals														
			Training	3.5.2	G												
		23 23 00	SD-02 Shop Drawings														
			Refrigerant Piping System	2.3	G												
			SD-03 Product Data														
			Refrigerant Piping System	2.3	G												
			Spare Parts	1.5.2	G												
			Qualifications	1.3.1	G												
			Refrigerant Piping Tests	3.5	G												
			Verification of Dimensions	3.1													
			SD-06 Test Reports														
			Refrigerant Piping Tests	3.5	G												
			SD-07 Certificates														
			Service Organization	2.1													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 23 00	SD-10 Operation and Maintenance Data														
			Maintenance	1.5	G												
			Operation and Maintenance Manuals	3.4	G												
			Demonstrations	3.4	G												
		23 25 00	SD-03 Product Data														
			Water Treatment System	2.1	G AE												
			Package Glycol Feeder														
			Water Analysis	2.1.3	G AE												
			Spare Parts	1.4													
			Field Instructions	3.4.1													
			Tests	3.3.1	G AE												
			Training Course	3.4.1	G												
			SD-10 Operation and Maintenance Data														
			Water Treatment System	2.1	G												
			Package Glycol Feeder														
		23 30 00	SD-02 Shop Drawings														
			Detail Drawings	1.6.4	G AE												
			SD-03 Product Data														
			Insulated Nonmetallic Flexible Duct Runouts	2.8.1.1	G												
			Duct Connectors	2.8.1.1													
			Duct Access Doors	2.8.2	G												
			Fire Dampers	2.8.3	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	CLASSIFICATION GOVT OR CLASSIFIED REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 30 00	Manual Balancing Dampers	2.8.4	G												
			Sound Attenuation Equipment	2.8.6	G AE												
			Diffusers	2.8.7.1													
			Registers and Grilles	2.8.7.2	G												
			Louvers	2.8.8	G												
			Air Vents and Goosenecks	2.8.9	G												
			Ozone Depleting Substances	2.15	S												
			Centrifugal Fans	2.9.1.1	G AE												
			In-Line Centrifugal Fans	2.9.1.2	G AE												
			Variable Volume, Single Duct	2.11.1.1	G AE												
			Terminal Units														
			Reheat Units	2.11.1.2	G												
			Air Handling Units	2.10	G AE												
			Energy Recovery Devices	2.12	G												
			Test Procedures	1.6.5													
			Diagrams	1.3.1.2	G												
			Indoor Air Quality for Duct	2.8.1	S												
			Sealants														
			Indoor Air Quality for Filter Media	2.7	S												
			SD-06 Test Reports														
			Performance Tests	3.12	G												
			Damper Acceptance Test	3.10	G												
			SD-07 Certificates														
			Bolts	1.6.1													
			Bolts	1.6.4													
			Bolts	2.5													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION REVIEW OR A/E	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 30 00	Ozone Depleting Substances	1.6.3													
			Technician Certification														
			SD-08 Manufacturer's Instructions														
			Manufacturer's Installation	3.2	G												
			Instructions														
			Operation and Maintenance	3.14.2	G												
			Training														
			SD-10 Operation and Maintenance														
			Data														
			Operation and Maintenance	3.14.1	G												
			Manuals														
			Fire Dampers	2.8.3	G												
			Manual Balancing Dampers	2.8.4	G												
			Centrifugal Fans	2.9.1.1	G												
			In-Line Centrifugal Fans	2.9.1.2	G												
			Air Handling Units	2.10	G												
			Variable Volume, Single Duct	2.11.1.1	G												
			Terminal Units														
			Energy Recovery Devices	2.12	G												
			Reheat Units	2.11.1.2	G												
			SD-11 Closeout Submittals														
			Indoor Air Quality During	3.13	S												
			Construction														
		23 52 00	SD-02 Shop Drawings														
			Detail Drawings	1.6	G AE												
			SD-03 Product Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I V W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 52 00	Materials and Equipment	2.1.1	G AE												
			Spare Parts	1.6													
			Water Treatment System	2.1.1	G AE												
			Boiler Water Treatment	2.13	G AE												
			Packaged Glycol Feeder System	2.1.1	G AE												
			Heating System Tests	3.8	G AE												
			Fuel System Tests	3.11	G AE												
			Unit Heaters;	2.7	G AE												
			Centrifugal Fan Cabinet Unit	2.7.2	G AE												
			Heaters														
			Welding	1.4													
			Qualifications	3.8	G												
			Field Instructions	3.10													
			Tests	3.4	G												
			SD-06 Test Reports														
			Heating System Tests	3.8	G AE												
			Fuel System Tests	3.11	G AE												
			Packaged Glycol Feeder System	2.1.1	G AE												
			Water Treatment Testing	3.8.1	G AE												
			SD-07 Certificates														
			Bolts	3.3.9	G												
			Bolts	3.3.11.1	G												
			Bolts	3.3.11.2	G												
			SD-10 Operation and Maintenance														
			Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/E REVIEW WR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 52 00	Operation and Maintenance Instructions	3.10	G												
			Packaged Glycol Feeder System	2.1.1	G												
			Water Treatment System	2.1.1	G AE												
			SD-11 Closeout Submittals														
			Indoor Air Quality During Construction	3.9.2	S												
		23 81 00	SD-03 Product Data														
			Spare Parts	3.7.1	G												
			Posted Instructions	3.4	G												
			Coil Corrosion Protection	2.6.1	G												
			System Performance Tests	3.6	G												
			Training	3.4	G												
			Inventory	1.5	G												
			Environmental Data	2.2.2.5	G												
			Supplied Products	2.1	G												
			Manufacturer's Standard Catalog Data	2.2	G												
			Humidifier	2.5.2	G												
			Outdoor Air Handling Unit	2.3.1	G												
			Mini Split System Air Conditioners	2.3.2	G												
			Refrigerants	2.2.2.3	G												
			Refrigerants	2.4.1	G												
			Ozone Depleting Substances	2.2.2.3	G												
			SD-06 Test Reports														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V I O N	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 81 00	Refrigerant Tests, Charging, and Start-Up	3.5	G AE												
			System Performance Tests	3.6	G AE												
			SD-07 Certificates														
			Service Organizations	3.7.2	G												
			Ozone Depleting Substances Technician Certification	1.4	G												
			SD-10 Operation and Maintenance Data														
			Installation Manual for Each Type of Equipment	2.3	G												
			Operation and Maintenance Manuals	3.4	G												
			SD-11 Closeout Submittals														
			Ozone Depleting Substances	2.2.2.3	S												
		23 81 23	SD-03 Product Data														
			Computer Room Air Conditioner	2.1	G												
			Space Temperature Control	2.6.3	G AE												
			System Drawings														
			Filters	2.1.5													
			Refrigerants	1.5	S												
			Cold And Hot Aisle Containment Systems	2.2	G												
			Leak Detection	2.3.1.3	G												
			Ozone Depleting Substances	2.9	G AE												
			SD-06 Test Reports														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V O W N R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 81 23	Manufacturer's Factory Test Plans	2.8.1	G AE												
			Factory Test Reports	2.8.4	G AE												
			Field Test Schedule	3.3.2	G AE												
			Manufacturer's Field Test Plans	3.3.1	G AE												
			Field Test Reports	3.3.6	G AE												
			SD-07 Certificates														
			Certificate of Specification Compliance	2.4	G AE												
			Credentials of the Manufacturer's Field Test Representative	3.3.3	G AE												
			Ozone Depleting Substances Technician Certification	1.6.1													
			Certified List Of Qualified Permanent Service Organizations	1.7.3													
			SD-08 Manufacturer's Instructions														
			Installation Manual for Each Type of CRAC	3.1.2													
			Installation Manual for Each Type of Aisle Containment System	3.1.2													
			SD-10 Operation and Maintenance Data														
			Computer Room Air Conditioner Operation and Maintenance Data	3.1.3	G AE												
			SD-11 Closeout Submittals														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 81 23	Indoor Air Quality During Construction	3.2	S												
		25 05 11.21	SD-01 Preconstruction Submittals														
			Wireless and Wired Broadcast Communication Request	1.5.2	G												
			Device Account Lock Exception Request	3.3.2	G												
			Contractor Computer Cybersecurity Compliance Statements	1.10.1.6	G												
			Contractor Temporary Network Cybersecurity Compliance Statements	1.10.6	G												
			Cybersecurity Subject Matter Expert Qualifications	1.7.2													
			SD-02 Shop Drawings														
			Network Communication Report	1.8.1	G												
			Cybersecurity Riser Diagram	1.8.4	G												
			SD-03 Product Data														
			Control System Cybersecurity Documentation	1.8.6	G												
			SD-06 Test Reports														
			Wireless Communication Test Report	1.5.2	G												
			Control System Cybersecurity Testing Procedures	3.13.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I O W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 05 11.21	Control System Cybersecurity Testing Report	3.13.3	G												
			SD-07 Certificates														
			Software Licenses	1.9	G												
			SD-11 Closeout Submittals														
			Password Change Summary Report	3.4.5.4	G												
			Enclosure Keys	3.3.7	G												
			Software and Configuration Backups	1.8.3	G												
			Auditing Front End Software	3.5.3	G												
			Device Audit Record Upload Software	3.5.4.2	G												
			System Maintenance Tool Software	3.9	G												
			Vendor Guide Compliance Result Report	1.8.5	G												
			Control System Inventory Report	1.8.2	G												
			Integrity Verification Software	3.12.1	G												
		25 05 11.23	SD-01 Preconstruction Submittals														
			Device Account Lock Exception Request	3.3.2	G												
			Multiple Ethernet Connection Device Request	3.2.3.2	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REVIEW / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 05 11.23	Contractor Computer Cybersecurity Compliance Statements	1.10.1.6	G												
			Contractor Temporary Network Cybersecurity Compliance Statements	1.10.6	G												
			Cybersecurity Interconnection Schedule	1.8.2	G												
			Cybersecurity Subject Matter Expert Qualifications	1.7.2													
			Proposed STIG and SRG Applicability Report	1.8.1	G												
			SD-02 Shop Drawings														
			Network Communication Report	1.8.3	G												
			Cybersecurity Riser Diagram	1.8.6	G												
			SD-03 Product Data														
			Control System Cybersecurity Documentation	1.8.8	G												
			SD-06 Test Reports														
			Control System Cybersecurity Testing Procedures	3.14.1	G												
			Control System Cybersecurity Testing Report	3.14.3	G												
			SD-07 Certificates														
			Software Licenses	1.9	G												
			SD-11 Closeout Submittals														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	CLASSIFICATION GOVT OR A/E REVIEWER	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 05 11.23	Password Change Summary Report	3.4.5.5	G												
			Enclosure Keys	3.3.5	G												
			Software and Configuration Backups	1.8.5	G												
			Auditing Front End Software	3.5.3	G												
			Device Audit Record Upload Software	3.5.4.1	G												
			System Maintenance Tool Software	3.9	G												
			Control System Scanning Tools	3.11.2	G												
			STIG, SRG and Vendor Guide	1.8.7	G												
			Compliance Result Report														
			Control System Inventory Report	1.8.4	G												
		25 05 11.28	SD-01 Preconstruction Submittals														
			Device Account Lock Exception Request	3.3.2	G												
			Multiple Ethernet Connection Device Request	3.2.4.2	G												
			Contractor Computer Cybersecurity Compliance Statements	1.10.1.6	G												
			Cybersecurity Subject Matter Expert Qualifications	1.7.2	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 05 11.28	Contractor Temporary Network	1.10.6	G												
			Cybersecurity Compliance														
			Statements														
			Cybersecurity Interconnection	1.8.2	G												
			Schedule														
			Protection of Information At Rest	3.7.4	G												
			Proposal														
			Proposed STIG And SRG	1.8.1	G												
			Applicability Report														
			SD-02 Shop Drawings														
			Network Communication Report	1.8.3	G												
			Cybersecurity Riser Diagram	1.8.6	G												
			SD-03 Product Data														
			Control System Cybersecurity	1.8.8	G												
			Documentation														
			SD-07 Certificates														
			Software Licenses	1.9	G												
			SD-11 Closeout Submittals														
			Password Change Summary	3.4.5.5	G												
			Report														
			Enclosure Keys	3.3.7	G												
			Software and Configuration	1.8.5	G												
			Backups														
			Auditing Front End Software	3.5.3	G												
			Device Audit Record Upload	3.5.4.1	G												
			Software														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 05 11.28	System Maintenance Tool Software	3.9	G												
			Control System Scanning Tools	3.11.2	G												
			STIG, SRG and Vendor Guide	1.8.7	G												
			Compliance Result Report														
			Control System Inventory Report	1.8.4	G												
			Integrity Verification Software	3.13.2	G												
		25 10 10	SD-02 Shop Drawings														
			UMCS Contractor Design Drawings	3.2.2	G												
			Draft As-Built Drawings	3.2.3	G												
			Final As-Built Drawings	3.2.3	G												
			SD-03 Product Data														
			Product Data Sheets	2.1.5	G												
			Computer Software	2.4	G												
			Enclosure Keys	2.6.1	G												
			SD-05 Design Data														
			UMCS IP Network Bandwidth Usage Estimate	3.2.1	G AE												
			SD-06 Test Reports														
			Pre-Construction QC Checklist	1.7	G												
			Post-Construction QC Checklist	1.7	G												
			Existing Conditions Report	3.1	G												
			Start-Up and Start-Up Testing Report	3.6	G												
			PVT Phase I Procedures	3.7.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REV / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		25 10 10	PVT Phase I Report	3.7.2	G												
			PVT Phase II Report	3.7.3	G												
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance (O&M) Instructions	1.8	G												
			Preventive Maintenance Work Plan	3.8.7.1	G												
			Basic Training Documentation	3.9.1	G												
			Advanced Training Documentation	3.9.1	G												
			Refresher Training Documentation	3.9.1	G												
			SD-11 Closeout Submittals														
			Closeout QC Checklist	1.7	G												
		26 08 00	SD-06 Test Reports														
			Acceptance Tests and Inspections	3.1	G												
			SD-07 Certificates														
			Acceptance Test and Inspections Procedure	1.4.2	G												
		26 12 19.10	SD-02 Shop Drawings														
			Pad-mounted Transformer Drawings	1.5.1	G												
			SD-03 Product Data														
			Pad-mounted Transformers	2.2	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REV / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 12 19.10	SD-06 Test Reports														
			Acceptance Checks and Tests	3.6.1	G												
			SD-07 Certificates														
			Transformer Efficiencies	2.2.2.1	G												
			SD-09 Manufacturer's Field Reports														
			Transformer Test Schedule	2.7.1	G												
			Design Tests	2.7.2	G												
			Routine and Other Tests	2.7.3	G												
			SD-10 Operation and Maintenance Data														
			Transformer(s)	1.6.1	G												
		26 20 00	SD-02 Shop Drawings														
			Panelboards	2.13	G												
			Transformers	2.15	G												
			Cable Trays	2.3	G												
			Wireways	2.27	G												
			Marking Strips	3.1.9.1	G												
			Marking Strips	3.1.9.1	G												
			SD-03 Product Data														
			Receptacles	2.12	G												
			Circuit Breakers	2.13.3	G												
			Switches	2.10	G												
			Transformers	2.15	G												
			Enclosed Circuit Breakers	2.14	G												
			Motor Controllers	2.17	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I O W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 20 00	Manual Motor Starters	2.18	G												
			CATV Outlets	2.21.1	G												
			Secondary Bonding Busbar	2.22.3	G												
			Surge Protective Devices	2.28	G												
			SD-06 Test Reports														
			600-volt Wiring Test	3.5.2	G												
			Grounding System Test	3.5.6	G												
			Transformer Tests	3.5.3	G												
			Ground-fault Receptacle Test	3.5.4	G												
			Arc-fault Receptacle Test	3.5.5	G												
			SD-07 Certificates														
			Fuses	2.11	G												
			SD-09 Manufacturer's Field Reports														
			Transformer Factory Tests	2.30.1													
			SD-10 Operation and Maintenance Data														
			Electrical Systems	1.5.1	G												
		26 24 13	SD-02 Shop Drawings														
			Switchboard Drawings	1.5.2	G												
			SD-03 Product Data														
			Switchboard	2.2	G												
			SD-06 Test Reports														
			Switchboard Design Tests	2.5.1	G												
			Switchboard Production Tests	2.5.2	G												
			Acceptance Checks and Tests	3.4.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 24 13	SD-10 Operation and Maintenance Data														
			Switchboard Operation and Maintenance	1.6.1	G												
			SD-11 Closeout Submittals														
			Assembled Operation and Maintenance Manuals	1.6.2	G												
			Service Entrance Available Fault Current Label	2.8	G												
		26 27 13.10 30	SD-03 Product Data														
			Power Meters	2.1	G												
			Current	2.1.3	G												
			Potential Transformer	2.1.2	G												
			Communications Module	2.2.2	G												
			Protocol Modules	1.6.1	G												
			Data Recorder	1.6.2	G												
			SD-06 Test Reports														
			Acceptance Checks and Tests	3.2.1	G												
			SD-10 Operation and Maintenance Data														
			Power Meters	2.1	G												
			Communications Module	2.2.2	G												
			Protocol Modules	1.6.1	G												
			SD-11 Closeout Submittals														
			System Function Verification	3.2.2	G												
		26 28 01.00 10	SD-03 Product Data														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 28 01.00 10	Fault Current Analysis	2.1													
			Protective Device Coordination Study	2.1													
		26 29 23	SD-02 Shop Drawings														
			Schematic Diagrams	1.5.1	G												
			Interconnecting Diagrams	1.5.2	G												
			Installation Drawings	1.5.3	G												
			As-Built Drawings	1.5.3	G												
			SD-03 Product Data														
			Adjustable Speed Drives	2.1	G												
			Wires and Cables	2.3													
			Equipment Schedule	1.5.4													
			SD-06 Test Reports														
			ASD Test	3.3.1													
			Performance Verification Tests	3.3.2													
			Endurance Test	3.3.3													
			SD-07 Certificates														
			Testing Agency's Field Supervisor	3.3.1	G												
			SD-08 Manufacturer's Instructions														
			Installation instructions	1.5.5													
			SD-09 Manufacturer's Field Reports														
			ASD Test Plan	2.5.1	G												
			Standard Products	1.5.6													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I O N W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 29 23	SD-10 Operation and Maintenance Data														
			Adjustable Speed Drives	2.1													
		26 41 00	SD-02 Shop Drawings														
			Overall lightning protection system	1.4.1.1	G												
			Each major component	1.4.1.2	G												
			SD-06 Test Reports														
			Lightning Protection and Grounding System Test Plan	1.4.3	G												
			Lightning Protection and Grounding System Test	3.4.1	G												
			SD-07 Certificates														
			Lightning Protection System Installers Documentation	1.2.3	G												
			Component UL Listed and Labeled	1.4.2	G												
			Lightning protection system inspection certificate	1.4.4	G												
			Roof manufacturer's warranty	3.1.1	G												
		26 42 13	SD-01 Preconstruction Submittals														
			Preconstruction Survey	1.8.2													
			SD-02 Shop Drawings														
			Drawings	2.1.2.5	G												
			Isolation flange kits	2.4.9													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 42 13	Anode junction boxes, bonding boxes, and test stations	2.3.4													
			Joint bonds	3.5.4													
			Contractor's Modifications	2.1.2.5	G												
			SD-03 Product Data														
			Qualifications	1.6.2													
			Equipment	1.5.1	G												
			Anodes	1.5.1	G												
			Anode junction boxes, bonding boxes, and test stations	2.3.4													
			Dielectric unions	2.4.11													
			Wires	2.3.1.1													
			Cable and wire	2.4.3													
			Casings, isolation, and seals	3.5.5													
			Shunts	2.3.2													
			Permanent reference electrodes	2.4.6	G												
			Spare Parts	1.5.1													
			SD-06 Test Reports														
			Tests and Measurements	3.6.1	G												
			Contractor's Modifications	2.1.2.5	G												
			SD-10 Operation and Maintenance Data														
			Cathodic Protection System	3.6	G												
			Cathodic Protection System	3.6	G												
			Training Course	1.5.1	G												
			SD-11 Closeout Submittals														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REV / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 42 13	Initial Cathodic Protection System	3.6.1.12	G												
			Field Testing														
			One Year Warranty Period	3.6.1.14	G												
			Cathodic Protection System Field														
			Test Report														
			Final Cathodic Protection System	3.6.1.15	G												
			Field Test Report														
		26 51 00	SD-02 Shop Drawings														
			Luminaire Drawings	1.5.1	G												
			Occupancy/Vacancy Sensor	1.7.2	G												
			Coverage Layout														
			Lighting Control System One-Line	1.7.2	G												
			Diagram														
			Sequence of Operation for	2.5.1	G												
			Lighting Control System														
			SD-03 Product Data														
			Luminaires	2.2	G												
			Light Sources	2.3	G												
			LED Drivers	2.4	G												
			Luminaire Warranty	1.6.1	G												
			Lighting Controls Warranty	1.6.2	G												
			Local Area Controller	2.5.1.1.1	G												
			Switches	2.5.2.1	G												
			Wall Box Dimmers	2.5.2.2	G												
			Scene Wallstations	2.5.2.3	G												
			Occupancy/Vacancy Sensors	2.5.2.4	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS / FIC / REV / WORK	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 51 00	Photosensors	2.5.2.5	G												
			Time Clocks	2.5.2.6	G												
			Power Packs	2.5.2.4.5	G												
			Power Hook Luminaire Hangers	2.7.4	G												
			Exit Signs	2.6.1	G												
			SD-05 Design Data														
			Luminaire Design Data	1.5.2	G												
			SD-06 Test Reports														
			ANSI/IES LM-79 Test Report	1.5.3	G												
			ANSI/IES LM-80 Test Report	1.5.4	G												
			ANSI/IES TM-21 Test Report	1.5.5	G												
			ANSI/IES TM-30 Test Report	1.5.6	G												
			Occupancy/Vacancy Sensor	3.2.1.1	G												
			Verification Test														
			Photosensor Verification Test	3.2.1.1	G												
			SD-07 Certificates														
			LED Driver and Dimming Switch	1.5.7	G												
			Compatibility Certificate														
			SD-10 Operation and Maintenance														
			Data														
			Lighting System	1.7.1	G												
			Lighting Control System	1.7.2	G												
			Maintenance Staff Training Plan	3.3.2.1	G												
			End-User Training Plan	3.3.2.2	G												
		26 56 00	SD-02 Shop Drawings														
			Luminaire Drawings	1.5.1.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		26 56 00	Pole Drawings	1.5.1.2	G												
			Sequence of Operation for Exterior Lighting Control System	2.5.1	G												
			SD-03 Product Data														
			Luminaires	2.2	G												
			Light Sources	2.3	G												
			LED Drivers	2.4	G												
			Luminaire Warranty	1.7.1	G												
			Pole Warranty	1.7.2	G												
			Photosensors	2.5.2.1	G												
			Poles	2.6	G												
			Brackets	2.6.3													
			SD-05 Design Data														
			Luminaire Design Data	1.5.2	G												
			SD-06 Test Reports														
			ANSI/IES LM-79 Test Report	1.5.3	G												
			ANSI/IES LM-80 Test Report	1.5.4	G												
			ANSI/IES TM-21 Test Report	1.5.5	G												
			SD-08 Manufacturer's Instructions														
			Poles	2.6													
			SD-10 Operation and Maintenance Data														
			Lighting System	1.8.1	G												
			Exterior Lighting Control System	1.8.2	G												
			Maintenance Staff Training Plan	3.3.1.1	G												
			End-User Training Plan	3.3.1.2	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	CLASSIFICATION GOVT OR CLASSIFIED REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		27 10 00	SD-02 Shop Drawings														
			Telecommunications drawings	1.6.1.1	G												
			Telecommunications Space	1.6.1.2	G												
			Drawings														
			SD-03 Product Data														
			Telecommunications cabling	2.3	G												
			Patch panels	2.4.5	G												
			Telecommunications	2.5	G												
			outlet/connector assemblies														
			Telecommunications	3.1	G												
			outlet/connector assemblies														
			Equipment support frame	2.4.2	G												
			Connector blocks	2.4.3	G												
			Spare Parts	1.10.3	G												
			SD-06 Test Reports														
			Telecommunications cabling	3.5.1	G												
			testing														
			SD-07 Certificates														
			Telecommunications Contractor	1.6.2.1	G												
			Key Personnel	1.6.2.2	G												
			Manufacturer Qualifications	1.6.2.3	G												
			Test plan	1.6.3	G												
			SD-09 Manufacturer's Field														
			Reports														
			Factory reel tests	2.10.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I O W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		27 10 00	SD-10 Operation and Maintenance Data														
			Telecommunications cabling and pathway system	1.10.1	G												
			SD-11 Closeout Submittals Record Documentation	1.10.2	G												
		28 08 10	SD-05 Design Data Test Plan	3.1	G												
			SD-06 Test Reports Draft Test Report	3.2.2													
			Final Test Report	3.4	G												
			SD-07 Certificates Qualifications	1.4.1													
		28 10 05	SD-02 Shop Drawings ESS Components	1.3.3.1	G AE												
			Overall System Schematic	1.3.3.2	G AE												
			SD-03 Product Data Premise Control Unit	2.3.6	G												
			Detection Sensors	2.3.7	G												
			Access Control Unit	2.4.4	G												
			Access Control Devices	2.4.5	G												
			Cameras	2.5.1	G												
			Camera Lenses	2.5.1.2	G												
			Camera Housing and Mounts	2.5.1.3	G												
			Network Switch	2.7.3	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V I E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		28 10 05	Uninterruptible Power Supply (UPS)	2.9.1	G												
			Batteries	2.9.2	G												
			Component Enclosure	2.10	G												
			SD-05 Design Data														
			Backup Battery Capacity Calculations	1.5.1	G AE												
			Throughput Rates	2.4.2	G AE												
			CCTV Storage Calculations	1.5.2													
			SD-07 Certificates														
			Contractor Qualifications	1.3.4.1	G												
			Instructor Qualifications	1.3.4.2	G												
			Data Encryption	2.7.2	G												
			SD-10 Operation and Maintenance Data														
			ESS Components	1.3.3.1	G												
			ESS Software	1.6	G												
			SD-11 Closeout Submittals														
			As-Built Drawings	1.7	G												
		28 31 76	SD-01 Preconstruction Submittals														
			Qualified Fire Protection Engineer (QFPE)	1.3.2	G												
			Fire alarm system designer	1.8.2.1	G												
			Supervisor	1.8.2.2	G												
			Technician	1.8.2.3	G												
			Installer	1.8.2.4	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V I E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		28 31 76	Test Technician	1.8.2.5	G												
			Fire Alarm System Site-Specific	1.7	G												
			Software Acknowledgement														
			SD-02 Shop Drawings														
			Nameplates	1.8.1.3	G												
			Instructions	2.2.4	G AE												
			Wiring Diagrams	1.8.1.4	G AE												
			System Layout	1.8.1.5	G AE												
			Notification Appliances	1.8.1.6	G AE												
			Initiating devices	1.8.1.7	G AE												
			Amplifiers	1.8.1.8	G AE												
			Battery Power	1.8.1.9	G AE												
			Voltage Drop Calculations	1.8.1.10	G AE												
			SD-03 Product Data														
			Fire Alarm and Mass Notification	2.3	G AE												
			Control Unit (FMCU)														
			Local Operating Console (LOC)	1.4.4	G AE												
			Amplifiers	1.8.1.8	G AE												
			Tone Generators	2.5	G AE												
			Digitalized voice generators	2.5	G AE												
			LCD Annunciator	2.6.1	G AE												
			Manual Stations	2.7	G AE												
			Smoke Detectors	2.8	G AE												
			Duct Smoke Detectors	2.8.2	G AE												
			Heat Detectors	2.9	G AE												
			Multi-Criteria Detectors	2.10	G AE												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N OR A / E R E V I E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		28 31 76	Carbon monoxide detector	2.11	G AE												
			Addressable Interface Devices	2.12	G AE												
			Addressable Control Modules	2.13	G AE												
			Isolation Modules	2.14	G AE												
			Notification Appliances	1.8.1.6	G AE												
			Textual Display Sign Control Panel	1.6	G AE												
			Textual Display Signs	2.15.3	G AE												
			Batteries	2.17.1	G AE												
			Battery Chargers	2.17.2	G AE												
			Supplemental Notification Appliance Circuit Panels	2.17.1.1	G AE												
			Auxiliary Power Supply Panels	2.17.1.1	G AE												
			Surge Protective Devices	2.18	G AE												
			Alarm Wiring	2.18	G AE												
			Back Boxes and Conduit	3.3.4	G AE												
			Ceiling Bridges	3.2.9	G AE												
			Terminal Cabinets	3.3.2	G AE												
			Digital Alarm Communicator Transmitter (DACT)	2.21.1	G AE												
			Automatic Fire Alarm Transmitters	2.21	G AE												
			Radio Transmitter and Interface Panels	2.20.1	G AE												
			Mass Notification Transceiver	2.20.1	G AE												
			Document Storage Cabinet	3.11.3	G AE												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		28 31 76	SD-06 Test Reports														
			Test Procedures	3.7.1	G												
			SD-07 Certificates														
			Verification of Compliant Installation	3.7.2.1	G												
			Request for Government Final Test	3.7.2.2	G												
			SD-10 Operation and Maintenance Data														
			Operation and Maintenance (O&M) Instructions	3.9	G												
			Instruction of Government Employees	3.10	G												
			SD-11 Closeout Submittals														
			As-Built Drawings	1.8.1.13													
			Spare Parts	1.10.1													
		31 00 00	SD-01 Preconstruction Submittals														
			Shoring	3.4	G												
			Dewatering Work Plan	1.4.2	G												
			SD-03 Product Data														
			Utilization of Excavated Materials	3.8	G												
			SD-06 Test Reports														
			Testing	3.15													
			Borrow Site Testing	2.1													
			SD-07 Certificates														
			Testing	3.15													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	CLASSIFICATION GOVT OR CLASSIFIED REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		31 00 00	Non-Hazardous Waste shipping manifest	3.7.1													
		31 63 29	SD-01 Preconstruction Submittals														
			Installation Plan	1.3.2													
			SD-02 Shop Drawings														
			Drilled Shaft Diameters	2.1.1	G												
			Depth of Test Holes	2.1.1	G												
			Top and Bottom of Shaft Elevations	2.1.1	G												
			Steel Reinforcement	2.1.1	G												
			Anchor Bolt Locations	2.1.1	G												
			Accessories	2.1.1	G												
			SD-05 Design Data														
			Drilled Shaft Foundation Design Analysis	2.1	G												
			Mix Design Data	2.1	G												
			Recycled Content for Steel	2.3.1	S												
			SD-06 Test Reports														
			Soils Report	3.3.1	G												
			Ground Water Conditions	3.3.1													
			Penetration Test	3.3.1	G												
			Slump	3.3.1													
			Concrete	3.3.1	G												
			Compressive Strength	3.3.1	G												
			SD-07 Certificates														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		31 63 29	Bill of Lading for Ready-Mix Concrete Deliveries	2.1													
			Steel Reinforcement	2.1.1	G												
			Welding Certificates	1.3.6	G												
			Excavation and Drilling Equipment	2.2.1													
			Qualifications of Excavator	1.3.4	G												
			Qualifications of Engineer	1.3.5	G												
		32 05 33	SD-01 Preconstruction Submittals														
			Integrated Pest Management Plan	2.4	G												
			SD-03 Product Data														
			Fertilizer	2.1	G												
			Mulches Topdressing	2.3													
			Organic Mulch Materials	2.3.2													
			SD-07 Certificates														
			Maintenance Inspection Report	3.5.1													
			Plant Quantities	3.5.2	G												
			SD-11 Closeout Submittals														
			Tree Staking and Guying Removal	3.5.3													
		32 11 23	SD-03 Product Data														
			Plant, Equipment, and Tools	1.4	G												
			SD-06 Test Reports														
			Initial Tests	2.3.1	G												
			In-Place Tests	3.12.1	G												

SUBMITTAL REGISTER												CONTRACT NO.					
TITLE AND LOCATION						CONTRACTOR											
Joint Cryptologic Center Building - Buckley SFB, CO																	
ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 12 16.16	SD-03 Product Data														
			Diamond Grinding Plan	2.1.5	G												
			Mix Design	2.4	G												
			Contractor Quality Control	3.1	G												
			Recycled Content for RAP in Mix	2.4.1	S												
			SD-06 Test Reports														
			Aggregates	2.2	G												
			QC Monitoring	3.1.3.9													
			SD-07 Certificates														
			Asphalt Cement Binder	2.3	G												
			Laboratory Accreditation and Validation	1.3.11													
		32 16 19	SD-03 Product Data														
			Concrete	2.1													
			SD-06 Test Reports														
			Field Quality Control	3.8													
		32 17 23	SD-03 Product Data														
			Surface Preparation Equipment List	2.1.1.1	G												
			Application Equipment List	2.1.2	G												
			Exterior Surface Preparation	3.2													
			Safety Data Sheets	1.3.1	G												
			Waterborne Paint	2.2.1	G												
			Thermoplastic compound	3.3.2	G												
			SD-06 Test Reports														
			Waterborne Paint	2.2.1	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 17 23	Thermoplastic Compound	3.3.2	G												
			Test Reports	3.4.1													
			SD-07 Certificates														
			Qualifications	1.3.2	G												
			Waterborne Paint	2.2.1													
			Volatile Organic Compound	1.3.1	G												
			Thermoplastic Compound	3.3.2													
			SD-08 Manufacturer's Instructions														
			Waterborne Paint	2.2.1	G												
			Thermoplastic Compound	3.3.2	G												
		32 92 19	SD-03 Product Data														
			Fertilizer	2.4													
			SD-06 Test Reports														
			Topsoil Composition Tests	2.2.2													
			SD-07 Certificates														
			Seed	2.1													
		32 93 00	SD-01 Preconstruction Submittals														
			State Landscape Contractor's	1.4.3													
			License														
			Time Restrictions and Planting	1.6													
			Conditions														
			SD-03 Product Data														
			Organic Mulch Materials	2.7.2													
			Gypsum	2.3.8													
			Mulch	2.7	G												
			Ground Stakes	2.8.1.2													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION OR A/ RE V E W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		32 93 00	Fertilizer	2.5													
			Weed Control Fabric	2.6	G												
			Staking Material	2.8.1													
			Antidesiccants	2.9													
			Photographs	1.4.4	G												
			SD-04 Samples														
			Mulch	2.7	G												
			SD-06 Test Reports														
			Topsoil Composition Tests	2.2.3													
			Percolation Test	1.4.5													
			SD-07 Certificates														
			Nursery Certifications	2.1.1													
			SD-10 Operation and Maintenance														
			Data														
			Plastic Identification	1.8													
		33 11 00	SD-01 Preconstruction Submittals														
			Connections	3.1.1	G												
			SD-03 Product Data														
			Pipe, Fittings, Joints and	2.1.1	G												
			Couplings														
			Valves	2.1.2	G												
			Valve Boxes	2.1.2.2	G												
			Fire Hydrants	2.1.3.1	G												
			Pipe Restraint	2.2.1	G												
			Disinfection Procedures	3.2.2	G												
			SD-06 Test Reports														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS OR S I F I C A T I O N	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 11 00	Bacteriological Samples	3.3.1.3	G												
			Leakage Test	3.3.1.2													
			Hydrostatic Test	3.3.1.1													
			SD-07 Certificates														
			Lining	2.1.1.1.1													
			Lining for Fittings	2.1.1.2.1.2													
			Valves	2.1.2													
			Fire Hydrants	2.1.3.1													
			SD-08 Manufacturer's Instructions														
			Ductile Iron Piping	2.1.1.1													
			PVC Piping	2.1.1.2.1.1													
		33 30 00	SD-01 Preconstruction Submittals														
			Contractor's License	1.3.1	G												
			SD-02 Shop Drawings														
			Installation Drawings	3.1.1	G												
			SD-03 Product Data														
			Precast Concrete Manholes	2.2.5													
			Frames, Covers, and Gratings	2.2.8													
			Gravity Pipe	2.2.1													
			SD-06 Test Reports														
			Low-Pressure Air Tests	3.3.1.1.1	G												
			SD-07 Certificates														
			Portland Cement	2.2.3													
			Gaskets	2.2.6													
		33 40 00	SD-04 Samples														

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS SIF CATION REVIEW	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 40 00	Pipe for Culverts and Storm Drains	2.1													
			SD-07 Certificates														
			Resin Certification	2.1.2													
			Oil Resistant Gasket	2.3.5.1													
			Hydrostatic Test on Watertight Joints	3.8.1.1													
			Determination of Density	3.8.1.2													
			Frame and Cover for Gratings	2.3.4													
			Post-Installation Inspection Report	3.8.2.1.3													
			Placing Pipe	3.3													
		33 51 15	SD-02 Shop Drawings														
			Pipe, Fittings, and Associated Materials	2.1													
			SD-03 Product Data														
			Materials and Equipment	2.1	G												
			Materials and Equipment	2.1	G												
			Spare Parts	1.6	G												
			Pipe and Accessory Coatings	2.1	G												
			SD-05 Design Data														
			Connections to Existing Lines	3.14	G												
			Connection and Abandonment Plan	3.14.2	G												
			SD-06 Test Reports														
			Pressure and Leak Tests	3.15.2													

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASSIFICATION	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/	APPROVING AUTHORITY				MAILED TO CONTR/	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION	DATE RCD FRM APPR AUTH	
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 51 15	SD-07 Certificates														
			Welder's training and qualifications	1.4.1.1													
			Jointing of Plastic Piping	1.4.1.2													
			Utility Work	3.14.1													
			SD-08 Manufacturer's Instructions														
			EFV Design and Installation Guide	2.3.2													
			SD-10 Operation and Maintenance Data														
			Gas Distribution System and Equipment Operation	3.16.1	G												
			Gas Distribution System Maintenance	3.16.2	G												
			Gas Distribution Equipment Maintenance	3.16.3	G												
		33 71 02	SD-02 Shop Drawings														
			Precast Underground Structures	1.4.1	G												
			SD-03 Product Data														
			Medium Voltage Cable	2.5	G												
			Precast Concrete Structures	2.10.2.1	G												
			Sealing Material	2.10.2.4													
			Pulling-In Irons	3.4.3													
			Manhole Frames and Covers	2.10.3	G												
			Handhole Frames and Covers	2.10.4	G												
			Composite/Fiberglass Handholes	2.10.5	G												

SUBMITTAL REGISTER

CONTRACT NO.

TITLE AND LOCATION

Joint Cryptologic Center Building - Buckley SFB, CO

CONTRACTOR

ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAGRAPH	GOVT CLASS S I F I C A T I O N O R A / E R E V I O W R	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION		DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	APPROVING AUTHORITY				MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
						SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION		DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		33 71 02	Cable Supports	2.11	G												
			SD-06 Test Reports														
			Field Acceptance Checks and Tests	3.13.1	G												
		33 82 00	SD-02 Shop Drawings														
			Telecommunications Outside Plant	1.6.1.1	G												
			Telecommunications Entrance Facility Drawings	1.6.1.2	G												
			SD-03 Product Data														
			Wire and cable	2.8	G												
			Cable splices, and connectors	2.5	G												
			Closures	2.3	G												
			Building protector assemblies	2.2.1	G												
			Protector modules	2.2.2	G												
			Cross-connect terminal cabinets	2.4	G												
			Spare Parts	1.8.2	G												
			SD-06 Test Reports														
			Pre-installation tests	3.5.1	G												
			Acceptance tests	3.5.2	G												
			Outside Plant Test Plan	1.6.3	G												
			SD-07 Certificates														
			Telecommunications Contractor	1.6.2.1	G												
			Key Personnel	1.6.2.2	G												
			Manufacturer's Qualifications	1.6.2.3	G												
			SD-08 Manufacturer's Instructions														

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 <i>(This section will be initiated by the contractor)</i>								
TO:		FROM:		CONTRACT NO.		CHECK ONE: <input type="checkbox"/> THIS IS A NEW TRANSMITTAL <input type="checkbox"/> THIS IS A RESUBMITTAL OF TRANSMITTAL _____		
SPECIFICATION SEC. NO. <i>(Cover only one section with each transmittal)</i>			PROJECT TITLE AND LOCATION		THIS TRANSMITTAL IS FOR: <i>(Check one)</i> <input type="checkbox"/> FIO <input type="checkbox"/> GA <input type="checkbox"/> DA <input type="checkbox"/> CR <input type="checkbox"/> DA/CR <input type="checkbox"/> DA/GA			
ITEM NO. <i>(See Note 3)</i> a.	DESCRIPTION OF SUBMITTAL ITEM <i>(Type size, model number/etc.)</i> b.	SUBMITTAL TYPE CODE <i>(See Note 8)</i> c.	NO. OF COPIES d.	CONTRACT DOCUMENT REFERENCE		CONTRACTOR REVIEW CODE g.	VARIATION Enter "Y" if requesting a variation <i>(See Note 6)</i> h.	USACE ACTION CODE <i>(Note 9)</i> i.
				SPEC. PARA. NO. e.	DRAWING SHEET NO. f.			
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 <i>(List by item No.)</i>		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 the 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 (<i>Specify</i>) K — Government concurs with intermediate design. (<i>For D-B contracts</i>) R — Design submittal is acceptable for release for construction. (<i>For D-B contracts</i>)
---	--
10. Approval of items does not relieve the contractor from complying with all the requirements of the contract.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 29

SUSTAINABILITY REQUIREMENTS AND REPORTING

02/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUMMARY
- 1.3 SUBMITTALS
- 1.4 GUIDING PRINCIPLES VALIDATION (GPV)
 - 1.4.1 Sustainability Action Plan
- 1.5 SUSTAINABILITY SUBMITTALS
 - 1.5.1 High Performance Sustainable Building (HPSB) Checklist
 - 1.5.1.1 HPSB Checklist Submittals
 - 1.5.2 Submittals for Sustainability Documentation
 - 1.5.3 Sustainability eNotebook
 - 1.5.3.1 Sustainability eNotebook Format
 - 1.5.3.2 Sustainability eNotebook Submittal Schedule
- 1.6 DOCUMENTATION REQUIREMENTS
 - 1.6.1 Commissioning (Cx)
 - 1.6.2 Energy Efficient Products
 - 1.6.3 Building-level Power Metering
 - 1.6.3.1 Construction Submittal Documentation
 - 1.6.4 Indoor Water Use
 - 1.6.5 Indoor Water Metering
 - 1.6.5.1 Construction Submittal Documentation
 - 1.6.6 Moisture Control
 - 1.6.6.1 Construction Submittal Documentation
 - 1.6.7 Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)
 - 1.6.8 Indoor Air Quality During Construction
 - 1.6.9 Recycled Content
 - 1.6.9.1 Construction Submittal Documentation
 - 1.6.10 Bio-Based Products
 - 1.6.11 Waste Material Management (Recycling - Construction)
 - 1.6.12 Additional Sustainability Requirements
 - 1.6.12.1 Third Party Certification (TPC) Documentation
 - 1.6.12.1.1 TPC Already Registered
 - 1.6.12.1.2 TPC Management and Certification

PART 2 PRODUCTS

PART 3 EXECUTION

- 3.1 SUSTAINABILITY COORDINATION
- 3.2 THIRD PARTY CERTIFICATION CERTIFICATE, ASSESSMENT, OR VALIDATION AND COMPLIANCE REPORT
- 3.3 TABLE 3-1 VOLATILE ORGANIC COMPOUNDS (VOC) (LOW EMITTING MATERIALS) REQUIREMENTS

-- 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.

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
--------------------	--

COUNCIL ON ENVIRONMENTAL QUALITY (CEQ) (WHITE HOUSE)

HPSB Guiding Principles	(2020) Guiding Principles for Sustainable Federal Buildings and Determining Compliance with the Guiding Principles for Sustainable Federal Buildings
-------------------------	--

GREEN BUSINESS CERTIFICATION INC. (GBCI)

GP Assessment (DOD)	Guiding Principles Assessment for Department of Defense
---------------------	---

INTERNATIONAL CODE COUNCIL (ICC)

ICC IGCC	(2018) 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) 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

UNDERWRITERS LABORATORIES (UL)

UL 2818

(2013) GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings

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". 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, S

Sustainability Action Plan; G, S

Preliminary Sustainability eNotebook; G, S

SD-11 Closeout Submittals

Final High Performance and Sustainable Building Checklist; G, S

Final Sustainability eNotebook; G, S

The Sustainability eNotebook shall include all relevant documentation pertaining to HPSB and TPC compliance including, but not limited to:

Commissioning Reports
Energy Efficient Products
Indoor Water Use
Low Emitting Materials
Bio-Based Products
Recycled Content
Certification of EPA Designated Items
USDA BioPreferred Program Certification
Construction Waste Management
Sustainability Submittals

Amended Final Sustainability eNotebook; G, S

Amended Final High Performance and Sustainable Building Checklist;
G, S

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

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, including all "S" submittals.
- d. Sustainability Action Plan.

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.

1.5 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 with each Sustainability eNotebook

submittal. Include the final HPSB Checklist(s) with the interim DD1354 Real Property Record Submittal.

1.5.2 Submittals for Sustainability Documentation

Various sections of this contract contain submittals that may count towards the sustainability documentation requirements required by this section. Submit the GPV and TPC sustainability documentation required in this section as part of the Sustainability eNotebook for all affected UFGS Sections.

- a. Highlight GPV and TPC compliance data in each sustainability documentation submittal.
- b. Bookmark sustainability documentation submittals as required in paragraph SUSTAINABILITY ENOTEBOOK below.
- c. Ensure all approved sustainability documentation submittals are included in each Sustainability eNotebook submittal.

1.5.3 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, 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. Sustainability documentation submittals contained in various UFGS sections of the contract
- f. Certifications, assessments, or validations and compliance report
- g. TPC documentation required in paragraph THIRD PARTY CERTIFICATION (TPC).

1.5.3.1 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.

1.5.3.2 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 in accordance with Section 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

b. Third Party Certification Design Compliance Report

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

c. Construction Quality Control Meetings.

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

e. Final Sustainability eNotebook

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

g. Amended Final Sustainability eNotebook

h. 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.

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/>.

Provide "off-the-shelf" products that utilize standby power mode with no more than one watt, or with the lowest possible standby power as listed in the FEMP's "Low Standby Power Product List" that are either ENERGY STAR-qualified and/ or Electronic Environmental Assessment Tool (EPEAT)-registered.

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 and natural gas, 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. Provide third party certified low-emitting materials in compliance with CDPH SECTION 01350 testing protocols including SCS Indoor Advantage Gold, EcoLogo UL 2818/ Greenguard, and the FloorScore program.

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, 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 or Indoor Air Quality Testing performed in compliance with IgCC Section 1001.3.1.5.

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.
- c. In order to complete compliance with FAR 52.223-9 Estimate of Percentage of Recovered Material Content for EPA Designated Items and FAR 52-223-17 Affirmative Procurement of EPA designated items in Service and Construction Contracts, submit the Certification of EPA Designated Items as part of the Final Sustainability eNotebook. Include on the certification form the following information: project

name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor. "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials:

- (1) The product does not meet appropriate performance standards;
- (2) The product is not available within a reasonable time frame;
- (3) The product is not available competitively (from two or more sources);
- (4) The product is only available at an unreasonable price (compared with a comparable non-recycled content product)."

Record each product used in the project that has a requirement or option of containing recycled content, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, exemptions (1), (2), (3), or (4), as indicated, and comments. Recycled content values may be determined by weight or volume percent, but must be consistent throughout.

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 Certification, to the maximum extent possible without jeopardizing the intended end use or detracting from the overall quality delivered to the end user and when available at a reasonable cost. Use only supplies and materials of a type and quality that conform to applicable specifications and standards.

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

- a. USDA BioPreferred label for each product; for bio-based products used on project but not listed with BioPreferred program, provide bio-based content and percentage.
- b. In order to complete compliance with FAR 52.223-1 Biobased Product Certification, refer to submittal requirement for biobased products in FSRIA 9002.

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.

Do not use ozone-depleting substances and high global warming potential (GWP) chemicals where EPAs Significant New Alternatives Policy (SNAP) Program has identified acceptable substitutes or where other environmentally preferable products are available for use in construction, repair, or end-of-life replacements. Provide product data for EPA SNAP compliance for refrigerants and other products as applicable.

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 Already Registered

Project is already registered with TPC organization to achieve GP Assessment (DOD). 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.

1.6.12.1.2 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.
- 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.
- 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.

1. Once Final Certification is achieved, turn over Administrative rights to online TPC to the Department of Public Works 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 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
- d. 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.

Deliver one original certificate, assessment, or validation, and compliance report to Contractor Officer, unless otherwise instructed.

Provide one original framed copy of the certificate, assessment, or validation, mounted in 25 mm 1 inch deep metal frames, with double matte, and wire hangers, in location approved by Contracting Officer.

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

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements				
Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)				
MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Adhesives and Sealants	CDPH/EHLB/Standard method V1.1 (California Section 01350) (Use "office" or "classroom" space limits for all applications)	and	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	Third party certification by SCS Indoor Advantage Gold or EcoLogo UL 2818/ Greenguard in compliance with CDPH version 1.1 testing protocols. (Use "office" or "classroom" space limits for all applications)	and	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	Third party certification by SCS Indoor Advantage Gold or EcoLogo UL 2818/ Greenguard in compliance with CDPH version 1.1 testing protocols. (Use "office" or "classroom" space limits for all applications)	and	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	Third party certification by SCS Indoor Advantage Gold or EcoLogo UL 2818/ Greenguard in compliance with CDPH version 1.1 testing protocols. (Use "office" or "classroom" space limits for all applications)	and	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, resilient flooring, and wall base, all locations: Third party certification by SCS Indoor Advantage Gold or EcoLogo UL 2818/ Greenguard or FloorScore or Carpet and Rug Institute Green Label Plus, in compliance with CDPH version 1.1 testing protocols.		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
Insulation	Third party certification by SCS Indoor Advantage Gold or EcoLogo UL 2818/ Greenguard, in compliance with CDPH version 1.1 testing protocols. (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	Third party certification by SCS Indoor Advantage Gold or EcoLogo UL 2818/ Greenguard, in compliance with CDPH version 1.1 testing protocols. (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.)

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
Office Furniture Systems and Seating installed prior to occupancy	ANSI/BIFMA X7.1 ANSI/BIFMA X7.1: (95-percent of installed office furniture system workstations and seating units) Section 7.6.2 of ANSI/BIFMA e3 (50-percent of office furniture system workstations and seating units)		none	none
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	Third party certification by SCS Indoor Advantage Gold or EcoLogo UL 2818/ Greenguard in compliance with CDPH version 1.1 testing protocols. (Use "office" or "classroom" space limits for all applications)		none	none

-- End of Section --

This page was intentionally left blank for duplex printing.

Air Force Sustainability Requirements Scoresheet

HPSB COMPLIANCE (Updated Jan 2017)

* required entry

General Information



Federal
Requirements
Complete

PTN 40171 (MILCON 491905)	Project ID (e.g. ABCD12345)
000000000000398224	Real Property Unique ID (RPUID)
unknown	Facility Number
Joint Cryptologic Center (JCC)	Building Name
Buckley AFB	Installation
Denver	City
CO	State
Yes	CONUS
AFSPC	MAJCOM
USACE	Construction Agent
Duane Bartley	AFCEC DM/CM (Last Name, First Name)
\$26,000,000.00	PA
32,480	Building Size (SF)
2022	Program Year (FY####)
Design Complete	Project Phase
11/05/20	Design Started (MM/DD/YY)
09/27/22	BOD (MM/DD/YY)
USGBC GP	Guiding Principles Compliance Certification Method
	<div>09/17/2021</div> <div>Date Project Registered (MM/DD/YY)</div>
	<div></div> <div>Date Project Certified (MM/DD/YY)</div>
100%	HPSB Compliant
21%	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
Yes	HPSB II.1	Energy Efficiency	1

Yes	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
20.9%	Insert percentage below ANSI/ASHRAE/IESNA Standard 90.1-2013 or IECC, in terms of energy use (e.g. 32)
2,485,869 kBtu/yr / 32,480 sqft = 76.5 kBtu/yr-sqft	Insert building energy intensity (kBtu/yr-sqft) calculated IAW 10 CFR 433
Yes	Roof Attributes (Recommended)
1	Select roof types (Check below)

- ☒ Cool roof
 ☐ Solar electric
 ☐ Solar Passive
☐ Green roof
 ☐ Solar thermal

Energy Efficient Products

Yes

N/A HPSB II.2

On-site Renewable Energy

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

N/A HPSB II.3

On-site Renewable Energy - Solar Hot Water Heater System

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

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
Yes	HPSB III.2	Outdoor Water	1
N/A		Outdoor Water Metering	1
N/A	HPSB III.3	Alternative Water	1
Yes	HPSB III.4	Stormwater Management (LID Documentation per UFC 3-210-10)	1

106099.0	Change in Impervious Area (SF)
	Pre-Award Cost Estimate (\$)
Yes	Project addressed EISA 438
3	EISA Technical Constraints

- ☐ Retaining stormwater impact receiving 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
 ☒ plumbing, and other mods not feasible
☐ State or local restrict water
 ☐ State or local restrict use of green
 ☒ Other

24.0%	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)
Both	LID Features Locations
3	Integrated Management Practices Employed

Air Force Sustainability Requirements Scoresheet

HPSB COMPLIANCE (Updated Jan 2017)

* required entry

- | | | | |
|--|---|--|--|
| <input type="checkbox"/> Bio-Retention | <input type="checkbox"/> Dry Wells | <input checked="" type="checkbox"/> Filter Strips | <input checked="" type="checkbox"/> Grassed Swells |
| <input type="checkbox"/> Infiltration Trench | <input type="checkbox"/> Inlet Pollution Removal Device | <input type="checkbox"/> Permeable Pavement/Pavers | <input type="checkbox"/> Rain Barrels/Cisterns |
| <input type="checkbox"/> Soil Amendments | <input type="checkbox"/> Tree Box Filters | <input type="checkbox"/> Vegetated Buffers | <input checked="" type="checkbox"/> Vege |
| <input type="checkbox"/> Other | | | |

Final LID Construction Cost (\$)

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
Yes	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		

This page was intentionally left blank for duplex printing.

PROJECT INFORMATION FORM		
Guiding Principles Assessment, Department of Defense by GBCI v2.1		
UFC 1-200-02: Chapter 2 Building Design & Construction, 01Dec16 Change 1 01Oct17		
General Information		
Project Name	JCC Building	100% submission
Project ID	1000149617	
Project City	Buckley AFB	
Project State	Colorado	
2-2 Employ Integrated Design Principles		
2-2.1 Integrated Design - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Integrated Design strategies have been incorporated through interdisciplinary collaboration of the Design Team, and will be supported by commissioning of the building systems and the building envelope.
2-2.1.1 Integrative Planning - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	The project team engaged in early stakeholder collaboration to enable stronger, more balanced design solutions in all aspects of the project through the sharing of knowledge and expertise. The Contractor will continue the integrated design process to the end of construction.
2-2.1.1 Evaluation for Design Strategies - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Passive and active building features such as exterior architectural shading devices, building envelope performance, lighting, plug load design, power densities, & HVAC strategies were considered. Hygrothermal characteristics of the building envelope design were analyzed to optimize the design with WUFI software (heat and moisture transiency).
2-2.1.3 Evaluation of the Site - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Jacobs engaged to provide planning and engineering services to develop a Customer Concept Document and DD1391 for the construction of JCC. CCD reports the initial findings of Planning Charrette held on 13 – 14 November 2019, subsequent inputs from the MPO, adjusted the program to an appropriately sized and equipped facility needed for training of NSAC personnel.
2-2.1.4 Site Integration and Design of the Building - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Pedestrian access is provided from walkways along the perimeter of the project site and to the existing fitness center. The walkway from North to the existing fitness center provides a strong pedestrian east-to-west link for this part of the installation. Various walkways within the project site provide access to building entrances and outdoor gathering spaces.

PROJECT INFORMATION FORM		
Guiding Principles Assessment, Department of Defense by GBCI v2.1		
UFC 1-200-02: Chapter 2 Building Design & Construction, 01Dec16 Change 1 01Oct17		
General Information		
Project Name	JCC Building	100% submission
Project ID	1000149617	
Project City	Buckley AFB	
Project State	Colorado	
2-2.2 Commissioning - Construction Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Path Two is also acceptable. Commissioning (Cx) must comply with IgCC Building Project Cx requirements and USACE ER 1110-345-723. A Design Cx Specialist (CxS) was on the Team for design-related requirements. Cx activities performed by the Construction Cx Specialist engaged for the Construction phase will extend until the systems deemed operable.
2-3 Optimize Energy Performance		
2-3.1.1 Commercial and Multi-Family High-Rise Residential Building - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	20.9% savings over ASHRAE 90.1-2013 does not meet 30% reduction due to Base requirements associated with utility availability, O+M concerns, mission-critical components, & AF standards. Priority was availability of technical maintenance & support, which is currently handled via local maintenance contract(s). Accordingly, equipment consistency from one facility has been addressed in coordination with USACE and USAF. BOD air handling equipment must be Trane, and BOD condensing boilers must be Lochinvar.
2-3.1.2 Low-Rise Residential Buildings - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Two: Not applicable	Not a Low-Rise Residential project.
2-3.1.3 Renovations - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Two: Not applicable	Not a Renovation.

PROJECT INFORMATION FORM		
Guiding Principles Assessment, Department of Defense by GBCI v2.1		
UFC 1-200-02: Chapter 2 Building Design & Construction, 01Dec16 Change 1 01Oct17		
General Information		
Project Name	JCC Building	100% submission
Project ID	1000149617	
Project City	Buckley AFB	
Project State	Colorado	
2-3.1.4 Energy Efficient Products - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Energy efficient products specified. FEMP criteria primarily impacts equipment and lighting, but also includes an ENERGY STAR (ES)-qualified roof.
2-3.1.5 Standby Powered Device - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Compliance specified in Section 013329, but none of the equipment in the design scope is subject to the criteria.
2-3.2 On-Site Renewable Energy - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Three: Not applicable	Security restrictions will not allow PV on roof.
2-3.2.1 Solar Domestic Hot Water (SDHW) - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Two: Not applicable	Found not to be LCCE.
2-3.4 Metering - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	The installation's advanced metering protocols have been incorporated. Sub-metering of HVAC, lighting and receptacles have been incorporated in the design.
2-4 Protect and Conserve Water		
2-4.1 Indoor Water - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Low flow fixtures specified to meet IgCC and WaterSense.
2-4.1.1 Indoor Water Metering - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Water metering to track domestic water consumption is included in the design in accordance with HPSB.
2-4.2.1 Outdoor Water Landscaping - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Regionally native / adaptive, drought-tolerant plants have been selected that do not require permanent irrigation.
2-4.2.2 Outdoor Water Metering - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Three: Not applicable	No irrigation proposed. Meter not needed/ required.
2-4.3 Alternate Water- Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Two: Not applicable	No irrigation proposed; automatic compliance with criteria.

PROJECT INFORMATION FORM		
Guiding Principles Assessment, Department of Defense by GBCI v2.1		
UFC 1-200-02: Chapter 2 Building Design & Construction, 01Dec16 Change 1 01Oct17		
General Information		
Project Name	JCC Building	100% submission
Project ID	1000149617	
Project City	Buckley AFB	
Project State	Colorado	
2-4.3.1 Stormwater Management - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Stormwater retention and/or use to the maximum extent technically feasible (METF) given contaminated soil. Filter strips, grassed swales.
2-5 Enhance Indoor Environmental Quality		
2-5.1 Part 1 - Ventilation - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	ASHRAE 62.1 ventilation will be exceeded. Ventilation and thermal comfort requirements have been addressed with passive and active controls. Effectiveness in preventing contaminants from passing into the air stream from mechanical ventilation will be enhanced with MERV 13 filters. Airflow monitoring will meet the requirements of UFC 3-410-01.
2-5.1 Part 2 - Thermal Comfort - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Utility consumption and controls for the HVAC system for Remotely monitored and controlled. Controls must be BACnet compatible and connected to the existing Base EMCS. Control strategies employed by the building must include air-side economizer, heat recovery, nighttime setback, optimized startup, supply air temperature reset.
2-5.2 Daylighting & Lighting Controls - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Daylighting criteria met with ASHRAE 189.1 compliance. Lighting control requirements met.
2-5.3.1 IAQ Moisture Control - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Pressure Testing the Air Barrier and IAQ Plan during construction specified.
2-5.3.2 Reduce VOC Low-Emitting Materials - Construction Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Two: LEED credit(s)	Low-emitting materials specified with LEED Forms for CA submittals.
2-5.3.3 Protect Indoor Air Quality During Construction - Construction Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Two: LEED credit(s)	IAQ Plan during construction specified.
2-5.4 Occupant Health and Wellness - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	Bike racks provided adjacent to the building. Fitness center located nearby. Water bottle-filling stations provided.

PROJECT INFORMATION FORM		
Guiding Principles Assessment, Department of Defense by GBCI v2.1		
UFC 1-200-02: Chapter 2 Building Design & Construction, 01Dec16 Change 1 01Oct17		
General Information		
Project Name	JCC Building	100% submission
Project ID	1000149617	
Project City	Buckley AFB	
Project State	Colorado	
2-6 Reduce Environmental Impact of Materials		
2-6.1.1 Recycled Content - Construction Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Two: LEED credit(s)	Recycled content materials specified with LEED Forms for CA submittals.
2-6.1.2 Biologically-Based Products - Construction Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path Two: LEED credit(s)	Criteria will be met to the extent feasible; LEED Forms for CA submittals.
2-6.1.4 Ozone Depleting Substances - Construction Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	HVAC equipment as basis of design utilize R410A refrigerants. Refrigerant options with lower GWP were discussed with vendors during early design, and it was recommended to retain R410A. According to EPA Rule 25 governing the SNAP policy, R410A will be phased out in 2024 for new system installations, however, construction scheduled to begin in 2023, the refrigerant specified will comply with EPA SNAP policy for refrigerants with ozone depleting substances and/or high GWP.
2-6.2.1 Storage and Collection of Recyclables - Design Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	The Base recycling program will be supported through provision of areas for collection and temporary storage of recyclable materials during the day-to-day operations in the building. There are (2) exterior dumpsters, with one dedicated to recycling collection.
2-6.2.2 Waste Diversion- Construction Submittal		
Select 1 of the 3 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Documenation:	Path Two: LEED credit(s)	Construction waste diversion from landfill specified.
2-7 Address Climate Change Risk		
2-7 Address Climate Change Risk - Design Submittal		
Select 1 of the 2 documentation paths Please see GPA DoD Technical Guide for details.		Notes:
Compliance Path:	Path One: Standard	The Base is not aware of or in possession of a Climate Change Risk Assessment for the Installation. DD1391 does not include any line item or funding for mitigating flood or other risk. Risk of hail damage discussed during Sustainability Design Work Session addressed through material selections and impact resistance requirements for building elements such as the roof.

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 33 39.00 10

ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS

10/15

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Advanced Modeling
 - 1.2.2 Model Element
 - 1.2.3 Facility/Site Data
 - 1.2.4 USACE BIM/CIM Platform Configuration Standards - Templates, Workspaces, Catalogs, and Environments
 - 1.2.5 IFC
 - 1.2.6 Model Uses
 - 1.2.7 USACE CAD/BIM Technology Center
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Advanced Modeling Project Execution Plan (PxP)
 - 1.4.1.1 USACE Minimum Modeling Matrix (M3)
 - 1.4.2 PxP Demonstration
 - 1.4.3 Advanced Modeling Submittals
 - 1.4.3.1 Approved PxP
 - 1.4.3.2 List of Submitted Files
 - 1.4.3.3 Model Submittal Checklist
 - 1.4.3.4 Advanced Modeling Electronic Files
 - 1.4.3.5 3D Interactive Review Model
 - 1.4.3.6 IFC Coordination View
 - 1.4.3.7 QC Reports
 - 1.4.3.7.1 Model Standards Checks and Reports
 - 1.4.3.7.2 Graphics Standards Checks and Report
 - 1.4.3.7.3 CAD Standards Checks and Report
 - 1.4.3.7.4 Other Parameters
 - 1.4.3.8 PDF Documents
 - 1.4.4 Advanced Modeling Re-Submittals
 - 1.4.4.1 Government Comments and Contractor Responses
 - 1.4.5 Meetings
 - 1.4.5.1 Pre-Construction Meeting
 - 1.4.5.2 Advanced Modeling Kick-Off Meeting
 - 1.4.5.3 PxP Demonstration Meeting
- 1.5 OWNERSHIP AND RIGHTS OF DATA
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.6.1 Number of Copies
 - 1.6.2 Malicious Content
 - 1.6.3 Storage Media
 - 1.6.3.1 Disk-Based Media
 - 1.6.4 Encryption

PART 2 PRODUCTS

- 2.1 GOVERNMENT FURNISHED MATERIALS
 - 2.1.1 GFM Handover
 - 2.1.2 GFM File Formats
 - 2.1.2.1 Government Furnished BIM
 - 2.1.2.2 Government Furnished CIM
 - 2.1.2.3 Government Furnished CAD
 - 2.1.3 Variation with Contract Drawings
 - 2.1.4 Model Completion and Quality
 - 2.1.5 Data Loss, Corruption, and Error
- 2.2 SYSTEM PLATFORM AND FILE FORMATS
 - 2.2.1 BIM
 - 2.2.2 CIM
 - 2.2.3 CAD
 - 2.2.4 Other Formats
 - 2.2.4.1 3D Interactive Review Model
 - 2.2.4.2 IFC
 - 2.2.4.3 PDF

PART 3 EXECUTION

- 3.1 ADVANCED MODELING REQUIREMENTS
 - 3.1.1 BIM and CIM
 - 3.1.1.1 Minimum Modeling Requirements
 - 3.1.1.2 USACE Software Configuration Standards
 - 3.1.1.3 Classification
 - 3.1.1.4 Space/Room Data
 - 3.1.1.5 BIM Coordinate System
 - 3.1.1.6 CIM Coordinate System
 - 3.1.1.7 Schedules
 - 3.1.1.8 Details and Enlarged Sections
 - 3.1.1.9 Drawing Indices
 - 3.1.1.10 CAD Export
 - 3.1.2 CAD
 - 3.1.2.1 USACE Software Standards
- 3.2 FINAL DESIGN AND FINAL RECORD SUBMITTAL REQUIREMENTS
- 3.3 PDF REQUIREMENTS
 - 3.3.1 PDF Bookmarks
 - 3.3.1.1 Construction Document Boookmarks
 - 3.3.1.2 As-Built Bookmarks
- 3.4 MODEL USES
 - 3.4.1 Mandatory Model Uses
 - 3.4.1.1 Construction Phase Mandatory Model Uses
 - 3.4.2 Optional Model Uses
- 3.5 AS-BUILT REQUIREMENTS

-- End of Section Table of Contents --

SECTION 01 33 39.00 10

ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS
10/15

PART 1 GENERAL

This project includes BIM, CIM, and CAD requirements during Construction phase of the project.

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 SCIENCE (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	(2015) A/E/C Graphics Standard, Release 2.0
ERDC/ITL TR-12-6	(2015) A/E/C CAD Standard - Release 6.0

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 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.

1.2.3 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.

1.2.4 USACE BIM/CIM Platform Configuration Standards - Templates, Workspaces, Catalogs, and Environments

a. Bentley AECOsing and InRoads Workspace:

The Workspace is contained within the A/E/C Work Structure. It is comprised of a collection of content libraries and supporting files that define and embody a BIM standard. Libraries include content such as wall types, standard steel shapes, furniture, HVAC fittings, and sprinkler heads. The Workspace also contains sheet libraries such as print/plot configurations, font and text style libraries, and sheet borders and title blocks. The Workspace includes pre-defined datagroup parameters.

b. USACE Revit Templates:

The USACE has developed Revit Templates specific to USACE BIM standards; these templates are Revit version specific. The USACE Revit templates are discipline specific and include family content pertinent to that discipline. The Templates share standard symbology such as annotation families, line styles, and text styles. The Templates include pre-defined shared parameters.

1.2.5 IFC

Industry Foundation Class, a standard and file format used for the exchange of BIM data; see www.iai-tech.org. For this specification, IFC does not mean "Issued For Construction."

1.2.6 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.

1.2.7 USACE CAD/BIM Technology Center

The USACE CAD/BIM Technology Center hosts all standard content for USACE. This content can be accessed through the CAD/BIM Technology Center website, <https://cadbimcenter.erd.cdrn.mil/>.

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

PxP Demonstration; G

SD-03 Product Data

Advanced Modeling Submittals; G

SD-11 Closeout Submittals

Final Design And Final Record Submittal; G

As-built Drawings; G

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 and update to include platforms and processes to meet the requirements of the project.

1.4.1.1 USACE 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.erdcdren.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

1.4.2 PxP Demonstration

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 Advanced Modeling Submittals

For each Advanced Modeling Submittal, provide the following:

1.4.3.1 Approved PxP

The most recent approved PxP.

1.4.3.2 List of Submitted Files

A list 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/Site Data. For all Sheet files, include a list of the sheet titles and sheet numbers.

1.4.3.3 Model Submittal Checklist

Complete the USACE BIM/CIM Submittal Checklist and submit with each submittal. Contractor can download the Checklist from the USACE CAD/BIM Technology Center.

1.4.3.4 Advanced Modeling Electronic Files

Include all Advanced Modeling files associated with the scope of work to be provided under this Contract. The Model(s) shall be developed, updated and maintained using Building Information Modeling (BIM), Civil Information Modeling (CIM), and Computer Aided Design (CAD) supplemented with drawing content as necessary to produce a complete set of Construction Documents.

1.4.3.5 3D Interactive Review Model

A copy of each BIM and CIM Model in an approved interactive review format.

1.4.3.6 IFC Coordination View

Provide an IFC Coordination View for all deliverables. Provide exported property set data for all IFC supported named building elements.

1.4.3.7 QC Reports

QC Reports will include the following:

1.4.3.7.1 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.

1.4.3.7.2 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.

1.4.3.7.3 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.

1.4.3.7.4 Other Parameters

Develop such other QC parameters as Contractor deems appropriate for the Project and provide to the Government for acceptance

1.4.3.8 PDF Documents

Provide one PDF file per discipline and one additional PDF file combining all disciplines, following the A/E/C CAD Standard discipline and drawing order.

1.4.4 Advanced Modeling Re-Submittals

For each Advanced Modeling Re-Submittal, provide the following:

1.4.4.1 Government Comments and Contractor Responses

Provide a response to each Government comment for backcheck.

1.4.5 Meetings

1.4.5.1 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:

1.4.5.2 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 PxP.

1.4.5.3 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.

1.5 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 the FAR Part 27. 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 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.

1.6.2 Malicious Content

Scan all files for malicious viruses using commercially available scanning program that is routinely updated to identify and remove current virus threats.

1.6.3 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 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.

1.6.3.1 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.

1.6.4 Encryption

Encrypt deliverable data as directed by Resident Office Engineer. Document the encryption to be used in the PxP.

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. The information and level of detail contained in the GFM shall be maintained in the Record Models and Record CAD files.

The Contractor has the option of preparing their own BIM/CIM models and CAD drawings as a basis for record model(s), record CAD drawings, and interim submittals. If so, the models must incorporate the same level of detail, properties, and functionality that is included in the GFM.

2.1.1 GFM Handover

The Government will provide the GFM at the Advanced Modeling Kick-Off Meeting.

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 VERSION 2021.1.5.

2.1.2.2 Government Furnished CIM

The GFM will include Autoddesk Civil3D VERSION 2018.

2.1.2.3 Government Furnished CAD

The GFM will include Autodesk AutoCAD VERSION 2013.

2.1.3 Variation with Contract Drawings

The Government makes no 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.

2.1.4 Model Completion and Quality

The Government makes no guarantee that the BIM/CIM models and CAD files provide the level of completeness or quality required for closeout submittal. It is the Contractor's responsibility to complete the models and facility data to completely and correctly represent the as-built conditions of the facility and the site.

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, and CAD application(s), software(s), and file format(s) described below:

2.2.1 BIM

The BIM submittal format will be Autodesk Revit VERSION. The BIM submittals shall be fully operable, compatible, and editable within the native BIM/CIM tools

2.2.2 CIM

The CIM submittal format will be Autodesk Civil 3D version. The CIM submittals shall be fully operable, compatible, and editable within the native BIM/CIM tools

2.2.3 CAD

The CAD submittal formats will be Autodesk AutoCAD VERSION. See 01 78 39.00 24 AS-BUILT DRAWINGS for additional requirements for 2D export of BIM files at contract closeout.

2.2.4 Other Formats

2.2.4.1 3D Interactive Review Model

The 3D Interactive Review Model format shall be Autodesk Navisworks VERSION or other Government Approved format documented in the PxP.

2.2.4.2 IFC

Submit all IFC models in the IFC2x3 Coordination View V2.0 schema.

2.2.4.3 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 M3 with the following modifications.

3.1.1.2 USACE Software Configuration Standards

a. USACE Bentley Workspace (Most recent version at the time of Contract award). Download from the USACE CAD/BIM Technology Center website as part of the A/E/C Work Structure.

b. USACE Revit Templates (Most recent version at the time of Contract award). Download from the USACE CAD/BIM Technology Center website and, if required, upgrade to the Contract approved software version.

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 BIM Coordinate System

- a. State Plane Coordinate System: Colorado
- b. Zone: Central (0502), with an applied combined scale factor of 1.000263810258
- c. Units: Imperial Feet
- d. Horizontal Datum: NAD 83
- e. Vertical Datum: as indicated on drawings

3.1.1.6 CIM Coordinate System

- a. State Plane Coordinate System: Colorado
- b. Zone: Central (0502), with an applied combined scale factor of 1.000263810258
- c. Units: Imperial Feet
- d. Horizontal Datum: NAD 83
- e. Vertical Datum: See civil drawings.

3.1.1.7 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.

3.1.1.8 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. Details and enlarged sections that are not derived from the Model must be created using native authoring tools within the Model or be embedded within the Model.

3.1.1.9 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.

3.1.1.10 CAD Export

CAD content exported from a BIM or CIM modeling platform shall comply with the NCS BIM Implementation section, part "2.0 Clarifications."

3.1.2 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.

3.1.2.1 USACE Software Standards

- b. Autodesk AutoCAD Template Files Most recent version at the time of Contract award. Download from 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 PDF REQUIREMENTS

3.3.1 PDF Bookmarks

3.3.1.1 Construction Document Bookmarks

Bookmark construction document PDF sets to include one Parent Bookmark per Discipline and one Child Bookmark per sheet within each Discipline. Format Parent Bookmarks as "<Discipline>" (i.e. Architectural). Format Child Bookmarks as "<Sheet ID> <Sheet Title>" (i.e. A-101 First Floor Plan).

3.3.1.2 As-Built Bookmarks

Bookmark each RFI, modification, or red-line drawing. Format each As-Built Bookmark as "<Sheet ID> <Sheet Title> <RFI/Modification/Red-Line> <RFI/Modification/Red-Line #>" (i.e. A-101 First Floor Plan RFI 0001).

3.4 MODEL USES

Include all of the following Model Uses in the Project Execution Plan (PxP).

3.4.1 Mandatory Model Uses

The following Model Uses are mandatory:

3.4.1.1 Construction Phase Mandatory Model Uses

- a. 3D Coordination
- b. Record Modeling

3.4.2 Optional Model Uses

Contractor may use other Model Uses as desired.

3.5 AS-BUILT REQUIREMENTS

See Section 01 78 39.00.24 AS-BUILT DRAWINGS for additional as-built drawings and record model quality and deliverable requirements.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

11/20, CHG 2: 11/21

PART 1 GENERAL

1.1 REFERENCES

1.2 DEFINITIONS

- 1.2.1 Competent Person (CP)
- 1.2.2 Competent Person, Confined Space
- 1.2.3 Competent Person, Cranes and Rigging
- 1.2.4 Competent Person, Excavation/Trenching
- 1.2.5 Competent Person, Fall Protection
- 1.2.6 Competent Person, Scaffolding
- 1.2.7 Competent Person (CP) Trainer
- 1.2.8 High Risk Activities
- 1.2.9 High Visibility Accident
- 1.2.10 Load Handling Equipment (LHE)
- 1.2.11 Medical Treatment
- 1.2.12 Near Miss
- 1.2.13 Operating Envelope
- 1.2.14 Qualified Person (QP)
- 1.2.15 Qualified Person, Fall Protection (QP for FP)
- 1.2.16 Recordable Injuries or Illnesses
- 1.2.17 Government Property and Equipment
- 1.2.18 Load Handling Equipment (LHE) Accident or Load Handling Equipment Mishap

1.3 SUBMITTALS

1.4 MONTHLY EXPOSURE REPORTS

1.5 REGULATORY REQUIREMENTS

1.6 SITE QUALIFICATIONS, DUTIES, AND MEETINGS

1.6.1 Personnel Qualifications

1.6.1.1 Site Safety and Health Officer (SSHO)

1.6.1.1.1 Additional Site Safety and Health Officer (SSHO) Requirements and Duties

1.6.1.2 Competent Person Qualifications

1.6.1.2.1 Competent Person for Confined Space Entry

1.6.1.2.2 Competent Person for Scaffolding

1.6.1.2.3 Competent Person for Fall Protection

1.6.1.3 Qualified Trainer Requirements

1.6.1.4 Crane Operators/Riggers

1.6.2 Personnel Duties

1.6.2.1 Duties of the Site Safety and Health Officer (SSHO)

1.6.3 Meetings

1.6.3.1 Preconstruction Conference

1.6.3.2 Safety Meetings

1.7 ACCIDENT PREVENTION PLAN (APP)

1.7.1 ACCIDENT PREVENTION PLAN (APP)

1.7.2 Names and Qualifications

1.7.3 Plans

- 1.7.3.1 Confined Space Entry Plan
- 1.7.3.2 Standard Lift Plan (SLP)
- 1.7.3.3 Critical Lift Plan - Crane or Load Handling Equipment
 - 1.7.3.3.1 Critical Lift Plan Planning and Schedule
 - 1.7.3.3.2 Lifts of Personnel
- 1.7.3.4 Multi-Purpose Machines, Material Handling Equipment, and Construction Equipment Lift Plan
- 1.7.3.5 Fall Protection and Prevention (FP&P) Plan
- 1.7.3.6 Rescue and Evacuation Plan
- 1.7.3.7 Hazardous Energy Control Program (HECP)
- 1.7.3.8 Excavation Plan
- 1.7.3.9 Site Safety and Health Plan
- 1.7.3.10 Site Demolition Plan
- 1.8 ACTIVITY HAZARD ANALYSIS (AHA)
 - 1.8.1 AHA Management
 - 1.8.2 AHA Signature Log
- 1.9 DISPLAY OF SAFETY INFORMATION
 - 1.9.1 Safety Bulletin Board
 - 1.9.2 Safety and Occupational Health (SOH) Deficiency Tracking System
- 1.10 SITE SAFETY REFERENCE MATERIALS
- 1.11 EMERGENCY MEDICAL TREATMENT
- 1.12 NOTIFICATIONS and REPORTS
 - 1.12.1 Mishap Notification
 - 1.12.2 Accident Reports
 - 1.12.3 LHE Inspection Reports
 - 1.12.4 Certificate of Compliance and Pre-lift Plan/Checklist for LHE and Rigging
- 1.13 HOT WORK
 - 1.13.1 Permit and Personnel Requirements
 - 1.13.2 Work Around Flammable Materials
- 1.14 RADIATION SAFETY REQUIREMENTS
- 1.15 CONFINED SPACE ENTRY REQUIREMENTS
 - 1.15.1 Entry Procedures
 - 1.15.2 Forced Air Ventilation
 - 1.15.3 Sewer Wet Wells
 - 1.15.4 Rescue Procedures and Coordination with Local Emergency Responders
- 1.16 SEVERE STORM PLAN

PART 2 PRODUCTS

PART 3 EXECUTION

- 3.1 CONSTRUCTION AND OTHER WORK
 - 3.1.1 Worksite Communication
 - 3.1.2 Hazardous Material Exclusions
 - 3.1.3 Unforeseen Hazardous Material
- 3.2 UTILITY OUTAGE REQUIREMENTS
- 3.3 OUTAGE COORDINATION MEETING
- 3.4 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)
 - 3.4.1 Safety Preparatory Inspection Coordination Meeting with the Government or Utility
 - 3.4.2 Lockout/Tagout Isolation
 - 3.4.3 Lockout/Tagout Removal
- 3.5 FALL PROTECTION PROGRAM
 - 3.5.1 Training
 - 3.5.2 Fall Protection Equipment and Systems
 - 3.5.2.1 Additional Personal Fall Protection Measures

- 3.5.2.2 Personal Fall Protection Equipment
- 3.5.3 Fall Protection for Roofing Work
- 3.5.4 Horizontal Lifelines (HLL)
- 3.5.5 Guardrails and Safety Nets
- 3.5.6 Rescue and Evacuation Plan and Procedures
- 3.6 WORK PLATFORMS
 - 3.6.1 Scaffolding
 - 3.6.2 Elevated Aerial Work Platforms (AWPs)
- 3.7 EQUIPMENT
 - 3.7.1 Material Handling Equipment (MHE)
 - 3.7.2 Load Handling Equipment (LHE)
 - 3.7.3 Machinery and Mechanized Equipment
 - 3.7.4 Use of Explosives
- 3.8 EXCAVATIONS
 - 3.8.1 Utility Locations
 - 3.8.2 Utility Location Verification
 - 3.8.3 Utilities Within and Under Concrete, Bituminous Asphalt, and Other Impervious Surfaces
- 3.9 ELECTRICAL
 - 3.9.1 Conduct of Electrical Work
 - 3.9.2 Qualifications
 - 3.9.3 Arc Flash
 - 3.9.4 Grounding
 - 3.9.5 Testing
- 3.10 AIRFIELD SAFETY PRECAUTIONS (DEC 1991)
 - 3.10.1 Definitions
 - 3.10.2 General
 - 3.10.3 Contractor Reporting, Notifications, and Operations Requirements
 - 3.10.4 Landing Areas
 - 3.10.5 Safety Precaution Areas

-- End of Section Table of Contents --

SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

11/20, 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.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B30.3	(2020) Tower Cranes
ASME B30.5	(2018) Mobile and Locomotive Cranes
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 B30.26	(2015; R 2020) Rigging Hardware

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

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	(2018; ERTA 1-2 2018) 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; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

NFPA 70E	(2021) Standard for Electrical Safety in the Workplace
NFPA 241	(2019) Standard for Safeguarding Construction, Alteration, and Demolition Operations
NFPA 306	(2019) Standard for the Control of Gas Hazards on Vessels

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 1926.1400	Cranes and Derricks in Construction
CPL 2.100	(1995) Application of the Permit-Required Confined Spaces (PRCS) Standards, 29 CFR 1910.146

1.2 DEFINITIONS

1.2.1 Competent Person (CP)

The CP is a person designated in writing, who, through training, knowledge and experience, is capable of identifying, evaluating, and addressing

existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authorization to take prompt corrective measures with regards to such hazards.

1.2.2 Competent Person, Confined Space

The CP, Confined Space, is a person meeting the competent person requirements as defined EM 385-1-1 Appendix Q, with thorough knowledge of OSHA's Confined Space Standard, 29 CFR 1910.146, and designated in writing to be responsible for the immediate supervision, implementation and monitoring of the confined space program, who through training, knowledge and experience in confined space entry is capable of identifying, evaluating and addressing existing and potential confined space hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.3 Competent Person, Cranes and Rigging

The CP, Cranes and Rigging, as defined in EM 385-1-1 Appendix Q, is a person meeting the competent person, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the Crane and Rigging Program, who through training, knowledge and experience in crane and rigging is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.4 Competent Person, Excavation/Trenching

A CP, Excavation/Trenching, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and 29 CFR 1926, who has been designated in writing to be responsible for the immediate supervision, implementation and monitoring of the excavation/trenching program, who through training, knowledge and experience in excavation/trenching is capable of identifying, evaluating and addressing existing and potential hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.5 Competent Person, Fall Protection

The CP, Fall Protection, is a person meeting the competent person requirements as defined in EM 385-1-1 Appendix Q and in accordance with ASSP Z359.0, who has been designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the fall protection program, who through training, knowledge and experience in fall protection and rescue systems and equipment, is capable of identifying, evaluating and addressing existing and potential fall hazards and, who has the authority to take prompt corrective measures with regard to such hazards.

1.2.6 Competent Person, Scaffolding

The CP, Scaffolding is a person meeting the competent person requirements in EM 385-1-1 Appendix Q, and designated in writing by the employer to be responsible for immediate supervising, implementing and monitoring of the scaffolding program. The CP for Scaffolding has enough training, knowledge and experience in scaffolding to correctly identify, evaluate and address existing and potential hazards and also has the authority to take prompt corrective measures with regard to these hazards. CP qualifications must be documented including experience on the specific

scaffolding systems/types being used, assessment of the base material that the scaffold will be erected upon, load calculations for materials and personnel, and erection and dismantling. The CP for scaffolding must have a documented minimum of 8-hours of scaffold training to include training on the specific type of scaffold being used (e.g. mast-climbing, adjustable, tubular frame), in accordance with EM 385-1-1 Section 22.B.02.

1.2.7 Competent Person (CP) Trainer

A competent person trainer as defined in EM 385-1-1 Appendix Q, who is qualified in the training material presented, and who possesses a working knowledge of applicable technical regulations, standards, equipment and systems related to the subject matter on which they are training Competent Persons. A competent person trainer must be familiar with the typical hazards and the equipment used in the industry they are instructing. The training provided by the competent person trainer must be appropriate to that specific industry. The competent person trainer must evaluate the knowledge and skills of the competent persons as part of the training process.

1.2.8 High Risk Activities

High Risk Activities are activities that involve work at heights, crane and rigging, excavations and trenching, scaffolding, electrical work, and confined space entry.

1.2.9 High Visibility Accident

A High Visibility Accident is any mishap which may generate publicity or high visibility.

1.2.10 Load Handling Equipment (LHE)

LHE is a term used to describe cranes, hoists and all other hoisting equipment (hoisting equipment means equipment, including crane, derricks, hoists and power operated equipment used with rigging to raise, lower or horizontally move a load).

1.2.11 Medical Treatment

Medical Treatment is treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even when provided by a physician or registered personnel.

1.2.12 Near Miss

A Near Miss is a mishap resulting in no personal injury and zero property damage, but given a shift in time or position, damage or injury may have occurred (e.g., a worker falls off a scaffold and is not injured; a crane swings around to move the load and narrowly misses a parked vehicle).

1.2.13 Operating Envelope

The Operating Envelope is the area surrounding any crane or load handling equipment. Inside this "envelope" is the crane, the operator, riggers and crane walkers, other personnel involved in the operation, rigging gear between the hook, the load, the crane's supporting structure (i.e. ground or rail), the load's rigging path, the lift and rigging procedure.

1.2.14 Qualified Person (QP)

The QP is a person designated in writing, who, by possession of a recognized degree, certificate, or professional standing, or extensive knowledge, training, and experience, has successfully demonstrated their ability to solve or resolve problems related to the subject matter, the work, or the project.

1.2.15 Qualified Person, Fall Protection (QP for FP)

A QP for FP is a person meeting the definition requirements of EM 385-1-1 Appendix Q, and ASSP Z359.2 standard, having a recognized degree or professional certificate and with extensive knowledge, training and experience in the fall protection and rescue field who is capable of designing, analyzing, and evaluating and specifying fall protection and rescue systems.

1.2.16 Recordable Injuries or Illnesses

Recordable Injuries or Illnesses are any work-related injury or illness that results in:

- a. Death, regardless of the time between the injury and death, or the length of the illness;
- b. Days away from work (any time lost after day of injury/illness onset);
- c. Restricted work;
- d. Transfer to another job;
- e. Medical treatment beyond first aid;
- f. Loss of consciousness; or
- g. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (a) through (f) above

1.2.17 Government Property and Equipment

Interpret "USACE" property and equipment specified in USACE EM 385-1-1 as Government property and equipment.

1.2.18 Load Handling Equipment (LHE) Accident or Load Handling Equipment Mishap

A LHE accident occurs when any one or more of the eight elements in the operating envelope fails to perform correctly during operation, including operation during maintenance or testing resulting in personnel injury or death; material or equipment damage; dropped load; derailment; two-blocking; overload; or collision, including unplanned contact between the load, crane, or other objects. A dropped load, derailment, two-blocking, overload and collision are considered accidents, even though no material damage or injury occurs. A component failure (e.g., motor burnout, gear tooth failure, bearing failure) is not considered an accident solely due to material or equipment damage unless the component failure results in damage to other components (e.g., dropped boom, dropped

load, or roll over). Document an LHE mishap 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.

Since this work involves operations that handle combustible or hazardous materials, this person must have the ability to understand and follow

through on the air sampling, Personal Protective Equipment (PPE), and instructions of a Marine Chemist, Coast Guard authorized persons, or Certified Industrial Hygienist. Confined space and enclosed space work must comply with NFPA 306, OSHA 29 CFR 1915, Subpart B, "Confined and Enclosed Spaces and Other Dangerous Atmospheres in Shipyard Employment," or as applicable, 29 CFR 1910.146 for general industry.

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 are dismissed, project work will be stopped and will not be allowed to resume until a suitable replacement is approved and the above duties are again being effectively carried out.

1.6.3 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 Site Safety and Health Plan

Identify the safety and health aspects, and prepare in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES.

1.7.3.10 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 DFO. 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 DFO 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; Contract title; type of Contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (for example, type of construction equipment used and PPE used). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted. Assist and cooperate fully with the Government's investigation(s) of any mishap.

1.12.2 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. 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 21.0 through 21.0.06. Personal fall protection systems and equipment are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall protection systems are required when operating other equipment such as scissor lifts. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, travel, or while performing work.

3.5.2.2 Personal Fall Protection Equipment

Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. The use of body belts is not acceptable. Harnesses must have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Snap hooks and carabineers must be self-closing and self-locking, capable of being opened only by at least two consecutive deliberate actions and have a minimum gate strength of 3,600 lbs in all directions. Use webbing, straps, and ropes made of synthetic fiber. The maximum free fall distance when using fall arrest equipment must not exceed 6 feet, unless the proper

energy absorbing lanyard is used. Always take into consideration the total fall distance and any swinging of the worker (pendulum-like motion), that can occur during a fall, when attaching a person to a fall arrest system. Equip all full body harnesses with Suspension Trauma Preventers such as stirrups, relief steps, or similar in order to provide short-term relief from the effects of orthostatic intolerance in accordance with EM 385-1-1, Section 21.I.06.

3.5.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

(1) For work within 6 feet from unprotected edge of a roof having a slope less than or equal to 4:12 (vertical to horizontal), protect personnel from falling by the use of conventional fall protection systems (personal fall arrest/restraint systems, guardrails, or safety nets) in accordance with EM 385-1-1, Section 21 and 29 CFR 1926.500. A safety monitoring system is not adequate fall protection and is not authorized.

(2) For work greater than 6 feet from the unprotected roof edge, addition to the use of conventional fall protection systems the use of a warning line system is also permitted, in accordance with 29 CFR 1926.500 and EM 385-1-1, Section 21.L.

b. Steep-Sloped Roofs: Work on a roof having a slope greater than 4:12 (vertical to horizontal) requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also applies to residential or housing type construction.

3.5.4 Horizontal Lifelines (HLL)

Provide HLL in accordance with EM 385-1-1, Section 21.I.08.d.2. Commercially manufactured horizontal lifelines (HLL) must be designed, installed, certified and used, under the supervision of a qualified person, for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500). The competent person for fall protection may (if deemed appropriate by the qualified person) supervise the assembly, disassembly, use and inspection of the HLL system under the direction of the qualified person. Locally manufactured HLLs are not acceptable unless they are custom designed for limited or site specific applications by a Registered Professional Engineer who is qualified in designing HLL systems.

3.5.5 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1, Section 21.F.01 and 29 CFR 1926 Subpart M.

3.5.6 Rescue and Evacuation Plan and Procedures

When personal fall arrest systems are used, ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the

following: methods of rescue; methods of self-rescue or assisted-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP). The plan must be in accordance with the requirements of EM 385-1-1, ASSP Z359.2, and ASSP Z359.4.

3.6 WORK PLATFORMS

3.6.1 Scaffolding

Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Comply with the following requirements:

- a. Scaffold platforms greater than 20 feet in height must be accessed by use of a scaffold stair system.
- b. Ladders commonly provided by scaffold system manufacturers are prohibited for accessing scaffold platforms greater than 20 feet maximum in height.
- c. An adequate gate is required.
- d. Employees performing scaffold erection and dismantling must be qualified.
- e. Scaffold must be capable of supporting at least four times the maximum intended load, and provide appropriate fall protection as delineated in the accepted fall protection and prevention plan.
- f. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward.
- g. Special care must be given to ensure scaffold systems are not overloaded.
- h. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material are prohibited. The first tie-in must be at the height equal to 4 times the width of the smallest dimension of the scaffold base.
- i. Scaffolding other than suspended types must bear on base plates upon wood mudsills (2 in x 10 in x 8 in minimum) or other adequate firm foundation.
- j. Scaffold or work platform erectors must have fall protection during the erection and dismantling of scaffolding or work platforms that are more than 6 feet.
- k. Delineate fall protection requirements when working above 6 feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.6.2 Elevated Aerial Work Platforms (AWPs)

Workers must be anchored to the basket or bucket in accordance with

manufacturer's specifications and instructions (anchoring to the boom may only be used when allowed by the manufacturer and permitted by the CP). Lanyards used must be sufficiently short to prohibit worker from climbing out of basket. The climbing of rails is prohibited. Lanyards with built-in shock absorbers are acceptable. Self-retracting devices are not acceptable. Tying off to an adjacent pole or structure is not permitted unless a safe device for 100 percent tie-off is used for the transfer.

Use of AWP's must be operated, inspected, and maintained as specified in the operating manual for the equipment and delineated in the AHA. Operators of AWP's 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 Use of Explosives

Explosives must not be used or brought to the project site without prior written approval from the Contracting Officer. Such approval does not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, must be only where directed and in approved storage facilities. These facilities must be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

3.8 EXCAVATIONS

Soil classification must be performed by a competent person in accordance with 29 CFR 1926 and EM 385-1-1.

3.8.1 Utility Locations

Provide a third party, independent, private utility locating company to positively identify underground utilities in the work area.

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)

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 35 29.13

HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES

11/15

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 PRECONSTRUCTION SAFETY CONFERENCE
- 1.3 SUBMITTALS
- 1.4 PROJECT-SPECIFIC RACS MANAGEMENT PLAN (PSRMP)
- 1.5 ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN (APP/SSHP)
 - 1.5.1 Acceptance and Modifications
 - 1.5.2 Availability
- 1.6 STAFF ORGANIZATION, QUALIFICATION AND RESPONSIBILITIES
 - 1.6.1 Safety and Health Manager
 - 1.6.1.1 Additional Qualifications
 - 1.6.1.2 Responsibilities and Duties
 - 1.6.2 Site Safety and Health Officer
 - 1.6.2.1 Qualifications
 - 1.6.2.2 Responsibilities and Duties
 - 1.6.3 Occupational Physician
 - 1.6.4 Persons Certified in First Aid and CPR
 - 1.6.5 Safety and Health Technicians
- 1.7 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES
- 1.8 CERTIFICATE OF COLORADO-REQUIRED CABI TRAINING
- 1.9 INSPECTIONS
- 1.10 SAFETY AND HEALTH PHASE-OUT REPORT

PART 2 PRODUCTS

- 2.1 REGULATORY REQUIREMENTS
- 2.2 PERSONAL PROTECTIVE EQUIPMENT
 - 2.2.1 Site Specific PPE Program
 - 2.2.2 Levels of Protection
 - 2.2.3 PPE for Government Personnel
- 2.3 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

PART 3 EXECUTION

- 3.1 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION
- 3.2 TASK SPECIFIC HAZARDS, INITIAL PPE, HAZWOPER MEDICAL SURVEILLANCE AND TRAINING APPLICABILITY
- 3.3 TRAINING
 - 3.3.1 General HTRW Operations Training
 - 3.3.2 Pre-Entry Briefing
 - 3.3.3 Periodic Sessions
- 3.4 MEDICAL SURVEILLANCE PROGRAM
- 3.5 EXPOSURE MONITORING/AIR SAMPLING PROGRAM
- 3.6 HEAT STRESS MONITORING AND MANAGEMENT
- 3.7 SPILL AND DISCHARGE CONTROL

3.8 SITE CONTROL MEASURES

3.8.1 Work Zones

3.8.1.1 Exclusion Zone (EZ)

3.8.1.2 Contamination Reduction Zone (CRZ)

3.8.1.3 Support Zone (SZ)

3.8.2 Site Control Log

3.8.3 Communication

3.8.4 Site Security

3.9 PERSONAL HYGIENE AND DECONTAMINATION

3.9.1 Decontamination Facilities

3.9.2 Personnel Decontamination

3.9.3 Equipment Decontamination

3.9.3.1 Facilities for Equipment and Personnel

3.9.3.2 Procedures

-- End of Section Table of Contents --

SECTION 01 35 29.13

HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES
11/15

PART 1 GENERAL

Soils on the site are classified as Regulated Asbestos Containing Soils (RACS) per Colorado Code of Regulations (CCR) 6 CCR 1007-2 Part 1 and may contain construction debris and asbestos from previous demolition activities. See drawings showing existing site conditions. A state Certified Asbestos Building Inspector (CABI) with soils experience is required to be on site during land disturbing operations. Excavation and disturbance of RACS shall be conducted in accordance with applicable Colorado regulations and Buckley Air Force Base Specific Regulated Asbestos Contaminated Soil Management Plan attached to Section 31 00 00.

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 SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1 (2014) American National Standard for
Emergency Eyewash and Shower Equipment

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 85-115 (1985) Occupational Safety and Health
Guidance Manual for Hazardous Waste Site
Activities

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 1904 Recording and Reporting Occupational
Injuries and Illnesses

29 CFR 1910 Occupational Safety and Health Standards

29 CFR 1910.120 Hazardous Waste Operations and Emergency
Response

29 CFR 1926 Safety and Health Regulations for
Construction

29 CFR 1926.65 Hazardous Waste Operations and Emergency
Response

Buckley Air Force Base Specific Regulated Asbestos Contaminated Soil

Management Plan

1.2 PRECONSTRUCTION SAFETY CONFERENCE

Conduct a preconstruction safety conference prior to the start of site activities and after submission of the Accident Prevention Plan/Site Safety And Health Plan (APP/SSHP). The objective of the meeting is to discuss health and safety concerns related to the impending work, discuss project health and safety organization and expectations, review and answer comments and concerns regarding the APP/SSHP or other health and safety concerns. Ensure that those individuals responsible for health and safety at the project level are available and attend this meeting.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Project-Specific RACS Management Plan (PSRMP)

SD-02 Shop Drawings

Work Zones; G, RO

Decontamination Facilities; G, RO

SD-03 Product Data

Exposure Monitoring/Air Sampling Program

Site Control Log

SSHO's Daily Inspection Logs

amendments to the APP/SSHP

SD-07 Certificates

Certificate Of CABI Training

SD-11 Closeout Submittals

Safety And Health Phase-Out Report

1.4 PROJECT-SPECIFIC RACS MANAGEMENT PLAN (PSRMP)

Submit a Project-Specific RACS Management Plan (PSRMP) conforming to the requirements of Section 5.1 and 5.5 of the Buckley Air Force Base Specific Regulated Asbestos Contaminated Soil Management Plan attached to Section 31 00 00.

1.5 ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN (APP/SSHP)

Develop and implement a Site Safety and Health Plan in accordance with Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS, and attach to the Accident Prevention Plan (APP) as an appendix (APP/SSHP). Address all occupational safety and health hazards (traditional construction as well

as contaminant-related hazards) associated with asbestos disturbance operations within the APP/SSHP. Cover each SSHP element in sections 28.A.01 and 33.B of EM 385-1-1 and each APP element in Appendix A of EM 385-1-1. There are overlapping elements in Section 28.A.01 and Appendix A of EM 385-1-1. SSHP appendix elements that overlap with APP elements need not be duplicated in the APP/SSHP provided each safety and occupational health (SOH) issue receives adequate attention and is documented in the APP/SSHP. The APP/SSHP is a dynamic document, subject to change as project operations/execution change. Modify the APP/SSHP to address changing and previously unidentified health and safety conditions. Ensure that the APP/SSHP is updated accordingly. Submit amendments to the APP/SSHP to the Contracting Officer as the APP/SSHP is updated. For long duration projects resubmit the APP/SSHP to the Contracting Officer annually for review. The APP/SSHP must contain all updates.

1.5.1 Acceptance and Modifications

Prior to submittal, the APP/SSHP must be signed and dated by the Safety and Health Manager and the Site Superintendent. Submit for review 45 days prior to the Preconstruction Safety Conference. Deficiencies in the APP/SSHP will be discussed at the preconstruction safety conference, and must be revised to correct the deficiencies and resubmitted for acceptance. Onsite work must not begin until the plan has been accepted. Maintain a copy of the written APP/SSHP onsite. Changes and modifications to the APP/SSHP must be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer. Bring to the attention of the Safety and Health Manager, the Site Superintendent, and the Contracting Officer any unforeseen hazard that becomes evident during the performance of the work, through the Site Safety and Health Officer (SSHO) for resolution as soon as possible. In the interim, take necessary action to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted APP/SSHP is cause for stopping work until the matter has been rectified.

1.5.2 Availability

Make available the APP/SSHP in accordance with 29 CFR 1910.120, (b)(1)(v) and 29 CFR 1926.65, (b)(1)(v).

1.6 STAFF ORGANIZATION, QUALIFICATION AND RESPONSIBILITIES

Provide hazardous waste operations and emergency response organization in accordance with EM 385-1-1, Section 33.

1.6.1 Safety and Health Manager

Safety and Health Manager must be an Industrial Hygienist certified by the American Board of Industrial Hygiene.

Apply the following in conjunction with the required qualifications and responsibilities stated in EM 385-1-1, Section 33.C.01.

1.6.1.1 Additional Qualifications

The Safety and Health Manager must have the following qualifications:

- a. A minimum of 3 years experience in developing and implementing safety and occupational health programs at contaminated sites.
- b. Documented experience in supervising professional and technician level personnel.
- c. Documented experience in developing worker exposure assessment programs and air monitoring programs and techniques.
- d. Documented experience in managing personal protective equipment (PPE) programs and conducting PPE hazard evaluations for the types of activities and hazards likely to be encountered on the project.
- e. Working knowledge of state and Federal occupational safety and health regulations.

1.6.1.2 Responsibilities and Duties

- a. Development, implementation, oversight, and enforcement of the APP/SSHP.
- b. Provide onsite consultation as needed to ensure the APP/SSHP is fully implemented.
- c. Conduct initial site-specific training.
- d. Be available for consultation during the first 3 days of remedial activities and at the startup of each new major phase of work.
- e. Visit the site as needed for the duration of activities, to audit the effectiveness of the APP/SSHP.
- f. Be available for emergencies.
- g. Coordinate any modifications to the APP/SSHP with the Site Superintendent, the SSHO, and the Contracting Officer.
- h. Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE.
- i. Provide continued support for upgrading/downgrading of the level of personal protection.
- j. Serve as a member of the quality control staff.
- k. Review accident reports and results of daily inspections.
- l. Sign and date the APP/SSHP prior to submittal.

1.6.2 Site Safety and Health Officer

Designate an individual and one alternate as the Site Safety and Health Officer (SSHO). Include the name, qualifications (education and training summary and documentation), and work experience of the Site Safety and Health Officer and alternate in the APP/SSHP.

The Apply the following in conjunction with the required qualifications and responsibilities stated in EM 385-1-1, Section 33.C.02.

1.6.2.1 Qualifications

The following requirements are in addition to those in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS.

- a. A minimum of 1 year experience in implementing SOH programs at contaminated sites where Level C personal protective equipment was required.
- b. Meet 29 CFR 1910.120/29 CFR 1926.65 requirements for 40-hour initial and 8-hour supervisor training and, maintain 8-hour refresher training requirements.
- c. Specific training in personal and respiratory protective equipment, confined space entry and in the proper use of air monitoring instruments and air sampling methods including monitoring for ionizing radiation.
- d. Documented experience in construction techniques and construction safety procedures.
- e. Working knowledge of Federal and state occupational SOH regulations.

1.6.2.2 Responsibilities and Duties

The following requirements are in addition to those in Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS.

- a. Assist and represent the Safety and Health Manager in onsite training and the day to day onsite implementation and enforcement of the accepted APP/SSHP.
- b. Be assigned to the site on a full time basis for the duration of field activities. The SSHO will have no duties other than SOH related duties. If operations are performed during more than 1 work shift per day, a site Safety and Health Officer must be present for each shift.
- c. Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.
- d. Have authority to ensure site compliance with specified SOH requirements, Federal, state and OSHA regulations and all aspects of the APP/SSHP including, but not limited to, activity hazard analyses, air monitoring, use of PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, spill containment program, and preparation of records by performing a daily SOH inspection and documenting results on the Daily Safety Inspection Log in accordance with 29 CFR 1904.
- e. In coordination with site management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.
- f. Consult with and coordinate any modifications to the APP/SSHP with the Safety and Health Manager, the Site Superintendent, and the Contracting Officer.

- g. Conduct daily safety inspection and document SOH findings into the Daily Safety Inspection Log. Track noted SOH deficiencies to ensure that they are corrected.
- h. Conduct accident investigations and prepare accident reports.
- i. Serve as a member of the quality control staff on matters relating to SOH.

1.6.3 Occupational Physician

Utilize the services of a licensed physician, who is certified in occupational medicine by the American Board of Preventative Medicine, or who, by necessary training and experience is Board eligible. The physician must be familiar with the site's hazards and the scope of this project. Include the medical consultant's name, qualifications, and knowledge of the site's conditions and proposed activities in the APP/SSHP. The physician is responsible for the determination of medical surveillance protocols and for review of examination/test results performed in compliance with 29 CFR 1910.120, (f) and 29 CFR 1926.65, (f) and paragraph MEDICAL SURVEILLANCE PROGRAM.

1.6.4 Persons Certified in First Aid and CPR

At least two persons who are currently certified in first aid and CPR by the American Red Cross or other approved agency must be onsite at all times during site operations. They must be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section .1030. These persons may perform other duties but must be immediately available to render first aid when needed.

1.6.5 Safety and Health Technicians

For each work crew in the exclusion zone, one person, designated as a Safety and Health technician, must perform activities such as air monitoring, decontamination, and safety oversight on behalf of the SSHO. They must have appropriate training equivalent to the SSHO in each specific area for which they have responsibility and report to and be under the supervision of the SSHO.

1.7 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

Develop and implement an Emergency Response Plan, that meets the requirements of EM 385-1-1 Section 33.G, 29 CFR 1910.120 (l) and 29 CFR 1926.65 (l), as a section of the APP/SSHP. In the event of any emergency associated with remedial action, without delay, alert all onsite employees and as necessary offsite emergency responders that there is an emergency situation; take action to remove or otherwise minimize the cause of the emergency; alert the Contracting Officer; and institute measures necessary to prevent repetition of the conditions or actions leading to, or resulting in, the emergency. Train employees that are required to respond to hazardous emergency situations to their level of responsibility according to 29 CFR 1910.120 (q) and 29 CFR 1926.65 (q) requirements. Rehearse the plan regularly as part of the overall training program for site operations. Review the plan periodically and revised as necessary to reflect new or changing site conditions or information. Provide copies of the Emergency Response Portion of the accepted APP/SSHP to the affected local emergency response agencies. Address, as a minimum, the following

elements in the plan:

- a. Pre-emergency planning. Coordinate with local emergency response providers during preparation of the Emergency Response Plan. At a minimum, coordinate with local fire, rescue, hazardous materials response teams, police and emergency medical providers to assure all organizations are capable and willing to respond to and provide services for on-site emergencies. Ensure the Emergency Response Plan for the site is compatible and integrated with the local fire, rescue, medical and police security services available from local emergency response planning agencies.
- b. Personnel roles, lines of authority, communications for emergencies.
- c. Emergency recognition and prevention.
- d. Site topography, layout, and prevailing weather conditions.
- e. Criteria and procedures for site evacuation (emergency alerting procedures, employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control).
- f. Route maps to nearest prenotified medical facility. Site-support vehicles must be equipped with maps. At the beginning of project operations, drivers of the support vehicles must become familiar with the emergency route and the travel time required.
- g. Specific procedures for decontamination and medical treatment of injured personnel.
- h. Emergency alerting and response procedures including posted instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police departments, ambulance service, Federal, state, and local environmental agencies; as well as Safety and Health Manager, the Site Superintendent, the Contracting Officer and their alternates).
- i. Criteria for initiating community alert program, contacts, and responsibilities.
- j. Procedures for reporting incidents to appropriate government agencies. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the appropriate government agencies must be immediately notified. In addition, verbally notify the Contracting Officer and the local district safety office immediately and submit a written notification within 24 hours. Include within the report the following items:
 - (1) Name, organization, telephone number, and location of the Contractor.
 - (2) Name and title of the person(s) reporting.
 - (3) Date and time of the incident.
 - (4) Location of the incident, i.e., site location, facility name.

- (5) Brief summary of the incident giving pertinent details including type of operation ongoing at the time of the incident.
- (6) Cause of the incident, if known.
- (7) Casualties (fatalities, disabling injuries).
- (8) Details of any existing chemical hazard or contamination.
- (9) Estimated property damage, if applicable.
- (10) Nature of damage, effect on contract schedule.
- (11) Action taken to ensure safety and security.
- (12) Other damage or injuries sustained, public or private.

k. Procedures for critique of emergency responses and follow-up.

1.8 CERTIFICATE OF COLORADO-REQUIRED CABI TRAINING

A copy of a certificate of CABI training must be completed and submitted for each visitor performing CABI duties.

1.9 INSPECTIONS

Attach to and submit with the Daily Quality Control reports the SSHO's Daily Inspection Logs. Include with each entry the following: date, work area checked, employees present in work area, PPE and work equipment being used in each area, special SOH issues and notes, and signature of preparer.

1.10 SAFETY AND HEALTH PHASE-OUT REPORT

Submit a Safety and Health Phase-Out Report in conjunction with the project close out report, prior to final acceptance of the work. Include the following minimum information :

- a. Summary of the overall performance of SOH (e.g., accidents or incidents including near misses, unusual events, lessons learned).
- b. Final decontamination documentation including procedures and techniques used to decontaminate equipment, vehicles, and on site facilities.
- c. Summary of exposure monitoring and air sampling accomplished during the project.
- d. Signatures of Safety and Health Manager and SSHO.

PART 2 PRODUCTS

2.1 REGULATORY REQUIREMENTS

Comply with EM 385-1-1, 29 CFR 1926.65, 29 CFR 1910.120, OSHA requirements in 29 CFR 1910 and 29 CFR 1926 with work performed under this contract, and state specific OSHA requirements where applicable. Submit to the Contracting Officer for resolution matters of interpretation of standards before starting work. The most stringent requirements apply where the requirements of this specification, applicable laws, criteria, ordinances,

regulations, and referenced documents vary.

2.2 PERSONAL PROTECTIVE EQUIPMENT

2.2.1 Site Specific PPE Program

Provide onsite personnel exposed to contaminants with appropriate personal protective equipment. Components of levels of protection must be relevant to site-specific conditions, including heat and cold stress potential and safety hazards. Use only respirators approved by NIOSH.

Keep protective equipment and clothing clean and well maintained. Include site-specific procedures to determine PPE program effectiveness and for onsite fit-testing of respirators, cleaning, maintenance, inspection, cartridge change out, and storage of PPE within the PPE section of the APP/SSHP.

2.2.2 Levels of Protection

The Safety and Health Manager must establish and evaluate as the work progresses the levels of protection for each work activity. Also establish action levels for upgrade or downgrade in levels of PPE. Describe in the SSHP the protocols and the communication network for changing the level of protection. Address air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, and individual medical considerations within the PPE evaluation protocol.

2.2.3 PPE for Government Personnel

Three clean sets of personal protective equipment (excluding air-purifying negative-pressure respirators and safety shoes, which will be provided by individual visitors), as required for entry into the contaminated areas of the site, must be available for use by the Contracting Officer or official visitors. The items must be cleaned, maintained and stored in a clean area and clearly marked: "FOR USE BY GOVERNMENT ONLY." Provide basic training in the use and limitations of the PPE provided as needed.

2.3 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

Maintain, as a minimum, the following items onsite and available for immediate use:

- a. First aid equipment and supplies approved by the consulting physician.
- b. Emergency eyewashes and showers that comply with ANSI/ISEA Z358.1.
- c. Provide fire extinguishers of sufficient size and type at site facilities and in all vehicles and at any other site locations where flammable or combustible materials present a fire risk.

PART 3 EXECUTION

3.1 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

See the Base Specific Regulated Asbestos Contaminated Soil Management Plan

for a description of the potential contamination at the site.3.2 TASK
SPECIFIC HAZARDS, INITIAL PPE, HAZWOPER MEDICAL SURVEILLANCE AND TRAINING
APPLICABILITY

Identify specific hazards, medical surveillance, required training and task specific PPE requirements for the project in the APP/SSHP. Reevaluate occupational safety and health hazards as the work progresses and to adjust the PPE and onsite operations, if necessary, so that the work is performed safely and in compliance with occupational safety and health regulations.

3.3 TRAINING

In conjunction with EM 385-1-1, Section 33D, meet the training program requirements for workers performing cleanup operations and who will be exposed to contaminants.

3.3.1 General HTRW Operations Training

All Personnel performing duties with potential for exposure to onsite contaminants must meet and maintain the following 29 CFR 1910.120/29 CFR 1926.65 (e) training requirements:

- a. 40 hours of off site HTRW instruction.
- b. 3 days actual on-the-job field experience under the direct supervision of a trained, experienced supervisor.
- c. 8 hours refresher training annually.

Onsite supervisors must have an additional 8 hours management and supervisor training specified in 29 CFR 1910.120/29 CFR 1926.65 (e) (4).

3.3.2 Pre-Entry Briefing

Prior to commencement of onsite field activities, all site employees, including those assigned only to the Support Zone, must attend a site-specific SOH training session. This session will be conducted by the Safety and Health Manager and the Site Safety and Health Officer to ensure that all personnel are familiar with requirements and responsibilities for maintaining a safe and healthful work environment. Thoroughly discuss procedures and contents of the accepted APP/SSHP and EM 385-1-1. Each employee must sign a training log to acknowledge attendance and understanding of the training. Notify the Contracting Officer at least 5 days prior to the initial site-specific training session so government personnel involved in the project may attend.

3.3.3 Periodic Sessions

Conduct periodic onsite training by the SSHO at least daily for personnel assigned to work at the site during the following day. Address SOH procedures, work practices, any changes in the APP/SSHP, activity hazard analyses, work tasks, or schedule; results of previous week's air monitoring, review of safety discrepancies and accidents. Convene a meeting prior to implementation of the change should an operational change affecting onsite field work be made, to explain SOH procedures. Conduct a site-specific training sessions for new personnel, visitors, and suppliers by the SSHO using the training curriculum outlines developed by the Safety and Health Manager. Each employee must sign a training log to acknowledge

attendance and understanding of the training.

3.4 MEDICAL SURVEILLANCE PROGRAM

Meet all requirements of 29 CFR 1910.120/29 CFR 1926.65 medical surveillance program and EM 385-1-1, workers who will be exposed to contaminants. Ensure the Occupational Physician or the physician's designee performs the physical examinations and reviews examination results. Participation in the medical surveillance program is without cost to the employee, without loss of pay and at a reasonable time and place.

3.5 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Prepare and implement by the Safety and Health Manager an exposure monitoring/air sampling program to identify and quantify SOH hazards and airborne levels of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment for affected site personnel. Include action levels for upgrading/downgrading PPE in the program. Submit personnel exposure monitoring/sampling results. Ensure compliance with Colorado regulations.

3.6 HEAT STRESS MONITORING AND MANAGEMENT

Document in the APP/SSHP and implement the procedures and practices in section 06.J. in EM 385-1-1 to monitor and manage heat stress.

3.7 SPILL AND DISCHARGE CONTROL

Develop and implement written spill and discharge containment/control procedures. Describe prevention measures, location of the spill control material; personal protective equipment required to cleanup spills; disposal of contaminated material; and who is responsible to report the spill. Storage of contaminated material or hazardous materials must be appropriately bermed, diked and contained to prevent any spillage of material on uncontaminated soil.

3.8 SITE CONTROL MEASURES

Coordinate site control measures with Section 01 57 20.00 10 ENVIRONMENTAL PROTECTION.

3.8.1 Work Zones

Initial anticipated work zone boundaries (exclusion zone, contamination reduction zone, support zone, all access points and decontamination areas) are to be clearly delineated on the site drawings. Base delineation of work zone boundaries on the contamination characterization data and the hazard/risk analysis to be performed as described in EM 385-1-1 06.A.02. As work progresses and field conditions are monitored, work zone boundaries may be modified (and site drawings modified) with approval of the Contracting Officer. Clearly identify work zones and mark in the field (using fences, tape, or signs). Submit and post a site map, showing work zone boundaries and locations of decontamination facilities in the onsite office. Work zones must consist of the following:

3.8.1.1 Exclusion Zone (EZ)

The exclusion zone is the area where hazardous contamination is either

known or expected to occur and the greatest potential for exposure exists. Control entry into this area and exit may only be made through the Contamination Reduction Zone (CRZ).

3.8.1.2 Contamination Reduction Zone (CRZ)

The CRZ is the transition area between the Exclusion Zone and the Support Zone. The personnel and equipment decontamination areas must be separate and unique areas located in the CRZ.

3.8.1.3 Support Zone (SZ)

The Support Zone is defined as areas of the site, other than exclusion zones and contamination reduction zones, where workers do not have the potential to be exposed to hazardous substances or dangerous conditions resulting from HTRW operations. Secure the Support Zone against active or passive contamination. Site offices, parking areas, and other support facilities must be located in the Support Zone.

3.8.2 Site Control Log

A log of personnel visiting, entering, or working on the site must be maintained. Include the following: date, name, agency or company, time entering and exiting site, time entering and exiting the exclusion zone (if applicable). Before visitors are allowed to enter the Contamination Reduction Zone or Exclusion Zone, they must show proof of current training, medical surveillance and respirator fit testing (if respirators are required for the tasks to be performed) and fill out a Certificate of Worker or Visitor Acknowledgment. Record this visitor information, including date, in the log.

3.8.3 Communication

Provide and install an employee alarm system that has adequate means of on and off site communication in accordance with 29 CFR 1910 Section .165. The means of communication must be able to be perceived above ambient noise or light levels by employees in the affected portions of the workplace. The signals must be distinctive and recognizable as messages to evacuate or to perform critical operations.

3.8.4 Site Security

Provide security to prevent entry of unauthorized personnel. Print signs in bold large letters on contrasting backgrounds. Signs must be visible from all points where entry might occur and at such distances from the restricted area that employees may read the signs and take necessary protective steps before entering.

3.9 PERSONAL HYGIENE AND DECONTAMINATION

Personnel entering the Exclusion or Contamination Reduction Zones or otherwise exposed to hazardous contaminated solids must decontaminate themselves and their equipment prior to exiting the contamination reduction zone (CRZ) and entering the support zone. Consult Chapter 10.0 of NIOSH 85-115 when preparing decontamination procedures. Submit a detailed discussion of personal hygiene and decontamination facilities and procedures to be followed by site workers as part of the APP/SSHP. Train employees in the procedures and enforce the procedures throughout site operations.

3.9.1 Decontamination Facilities

Submit drawings showing the layout of the personnel and equipment decontamination areas.

3.9.2 Personnel Decontamination

Initially set up a decontamination line in the CRZ. Employees must exit the exclusion zone through the CRZ and implement decontamination procedures and techniques outlined in the accepted APP/SSHP. It is the Site Safety and Health Officer's responsibility to recommend techniques to improve personnel decontamination procedures, if necessary.

3.9.3 Equipment Decontamination

Decontaminate the vehicles and equipment used in the EZ in the CRZ prior to leaving the EZ.

3.9.3.1 Facilities for Equipment and Personnel

Provide a equipment decontamination station within the CRZ for decontaminating vehicles and equipment leaving the EZ. Describe equipment decontamination locations and facilities in the approved APP/SSHP.

3.9.3.2 Procedures

Procedures for equipment decontamination must be developed and utilized to prevent the spread of contamination into the SZ and offsite areas. These procedures must address disposal of contaminated products and spent materials used on the site, including, as a minimum, containers, fluids, and oils. Assume any item taken into the EZ to be contaminated and perform an inspection and decontaminate. Vehicles, equipment, and materials must be cleaned and decontaminated prior to leaving the site. Handle construction material in such a way as to minimize the potential for contaminants being spread or carried offsite. Prior to exiting the site, vehicles and equipment must be monitored to ensure the adequacy of decontamination.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 41 26.05 24

(FEDERAL FACILITIES COLORADO) NPDES PERMIT REQUIREMENTS FOR STORM WATER
DISCHARGES FROM CONSTRUCTION SITES

12/21

PART 1 GENERAL

- 1.1 REFERENCES (Not Applicable)
- 1.2 SUBMITTALS

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

- 3.1 GENERAL
- 3.2 IMPLEMENTATION
 - 3.2.1 Notice of Intent
 - 3.2.2 Storm Water Pollution Prevention Plan
 - 3.2.2.1 General
 - 3.2.2.2 Acceptance of SWPPP
 - 3.2.2.3 Notification of Changes
 - 3.2.3 Posting Notice
 - 3.2.4 Inspections and Reporting
 - 3.2.4.1 Inspector Qualifications
 - 3.2.5 Maintenance
 - 3.2.6 Notice of Termination
 - 3.2.7 Retention of Records
 - 3.2.8 Continuation of Expired Permit

-- End of Section Table of Contents --

SECTION 01 41 26.05 24

(FEDERAL FACILITIES COLORADO) NPDES PERMIT REQUIREMENTS FOR STORM WATER
DISCHARGES FROM CONSTRUCTION SITES

12/21

PART 1 GENERAL

1.1 REFERENCES (Not Applicable)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. 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

Inspector Qualifications

Name and qualifications of all personnel who will be performing inspections on the site.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

Implement the terms and requirements of the attached National Pollutant Discharge Elimination System General Permit for Discharges from Construction Activities (Permit No. COR10F000, hereinafter called "the permit") as specified below. The Government and the Contractor shall be considered co-permittees. The Government has operational control over construction plans and specifications, including the ability to make modifications to those plans and specifications. The Contractor shall have day-to-day operational control of those activities which are necessary to ensure compliance with the requirements specified herein. The Contractor shall be responsible for all submissions to the EPA and shall retain the official copy of all documents pertaining to compliance with the permit during construction. The project site is not located in designated critical habitat and there are no known "listed species" located in the project area.

3.2 IMPLEMENTATION

3.2.1 Notice of Intent

The Contractor shall electronically complete and sign a Notice of Intent (NOI) in accordance with the Permit. Notify the Contracting Officer's

Representative within 24 hours after submitting his NOI. The Contractor shall not submit his NOI to the EPA until his Storm Water Pollution Prevention Plan has been accepted by the Government. After completion of the electronic NOI, a 14-calendar day waiting period begins. The EPA will give the Contractor authorization that his NOI is in effect after the 14-day waiting period. The Contractor may not begin land disturbance activities until authorized by the Contracting Officer.

3.2.2 Storm Water Pollution Prevention Plan

3.2.2.1 General

Prepare a Stormwater Pollution Prevention Plan (SWPPP) for the project. The SWPPP shall include all requirements described in the construction general permit. The Government will provide the Contractor with a BSFB SWPPP template for use. Include appropriate controls and measures for any off-site support activities covered under the permit. The SWPPP shall describe the nature and location of the activity and a location map and site map shall be included in accordance with the permit. The Contractor shall be responsible for implementing, maintaining and updating the SWPPP (including Site Map) during construction. Unless otherwise indicated, the Contractor shall be responsible for implementing all measures described in the SWPPPs. The Contractor shall maintain the following records and attach to the SWPPP: the dates when major grading activities occur; the dates when construction activities temporarily or permanently cease on a portion of the site; and the dates when stabilization measures are initiated. The SWPPP shall be signed by the Contractor and Government. A copy of the written authorization shall be attached to the SWPPP for any person signing the SWPPP or Inspection Reports other than the person described in the permit. If major changes to the SWPPP are required during construction, the SWPPP shall be recertified by the Contractor and the Government. The SWPPP shall remain active and the project subject to the rules and regulations outlined under the 2022 EPA construction general permit (CGP) until the project satisfies the notice of termination (NOT) criteria outlined in part 8 of the 2022 EPA CGP.

3.2.2.2 Acceptance of SWPPP

Acceptance of the Contractor's SWPPP is required prior to submitting a Notice of Intent (NOI) to the EPA and 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 to the SWPPP if the Contracting Officer determines that environmental protection requirements are not being met.

3.2.2.3 Notification of Changes

After acceptance of the Contractor's SWPPP, notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.2.3 Posting Notice

Post copies of each of the NOI's electronically submitted to the EPA using the NPDES eReporting Tool or "NeT" system. Post the NOI conspicuously near the main entrance of the construction site. Post the EPA spill/emergency contact sheet (provided in the SWPPP template) with the NOI at the main entrance of the construction site.

3.2.4 Inspections and Reporting

The Contractor is responsible for all inspections required by the general permit. Prepare and sign all reports summarizing the inspections as required by the construction general permit. Attach copies of inspection reports to the Contractor's SWPPP and provide to the Contracting Officer's Representative within 24 hours after completion of each inspection. Notify the COR and the stormwater coordinator at gregory.vierra.2.ctr@spaceforce.mil if an inspection identifies any incidents of non-compliance within the SWPPP and construction general permit.

3.2.4.1 Inspector Qualifications

Contractor personnel performing inspections shall be knowledgeable in the principles and practice of erosion and sediment controls and possess the skills to assess conditions at the construction site that could impact storm water quality and to assess the effectiveness of any sediment and erosion control measures selected to control the quality of storm water discharges from the construction site. Submit the name and qualifications of all personnel who will be performing inspections on the site.

3.2.5 Maintenance

Maintain all erosion and sediment control measures and other protective measures identified in the SWPPP in an effective operating condition. The Government reserves the right to require the Contractor to perform maintenance on erosion and sediment control measures and other protective measures if the Contracting Officer determines that environmental protection requirements are not being met.

3.2.6 Notice of Termination

Establish a stand of grass in all disturbed areas of the project not otherwise surfaced meeting the requirements for "Final Stabilization" as defined in the 2022 EPA CGP prior to terminating permit coverage. Notify the Contracting Officer within 2 working days after final stabilization on all portions of the site where achieved in accordance the permit. Electronically complete and sign a Notice of Termination (NOT) in accordance with the permit. Furnish a copy of the Contractor's NOT and the updated SWPPP to the Contracting Officer within 5 calendar days after final stabilization has been achieved on all portions of the site.

3.2.7 Retention of Records

Retain copies of all inspection reports and corrective action log for at least three years from the date permit coverage terminates or expires. After submission of the Contractor's NOT, the Government is responsible for retaining copies of the SWPPP and all reports in accordance with the permit.

3.2.8 Continuation of Expired Permit

If the current permit expires prior to completion of construction, the Contractor shall comply with the conditions of the new permit.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS

02/19

PART 1 GENERAL

1.1 REFERENCES

1.2 ORDERING INFORMATION

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section Table of Contents --

SECTION 01 42 00

SOURCES FOR REFERENCE PUBLICATIONS
02/19

PART 1 GENERAL

1.1 REFERENCES

Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g., ASTM B564 Standard Specification for Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.2 ORDERING INFORMATION

The addresses of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

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@aaashto.org
Internet: <https://www.transportation.org/>

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)
1 Davis Drive
P.O. Box 12215
Research Triangle Park, NC 27709-2215
Ph: 919-549-8141
Fax: 919-549-8933
Internet: <https://www.aatcc.org/>

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)
330 N. Wabash Ave., Suite 2000
Chicago, IL 60611
Ph: 202-367-1155
E-mail: info@americanbearings.org
Internet: <https://www.americanbearings.org/>

AMERICAN CONCRETE INSTITUTE (ACI)
38800 Country Club Drive
Farmington Hills, MI 48331-3439
Ph: 248-848-3700
Fax: 248-848-3701
Internet: <https://www.concrete.org/>

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)
1330 Kemper Meadow Drive
Cincinnati, OH 45240
Ph: 513-742-2020
Fax: 513-742-3355
Internet: <https://www.acgih.org/>

AMERICAN GAS ASSOCIATION (AGA)
400 North Capitol Street, NW
Suite 450
Washington, D.C. 20001
Ph: 202-824-7000
Internet: <https://www.aga.org/>

AMERICAN HARDBOARD ASSOCIATION (AHA)
1210 West Northwest Highway
Palatine, IL 60067
Ph: 847-934-8800
Fax: 847-934-8803
E-mail: aha@hardboard.org
Internet: <http://domensino.com/AHA/>

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
130 East Randolph, Suite 2000
Chicago, IL 60601
Ph: 312-670-5444
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>

AmericanHort (AH)
2130 Stella Court
Columbus, OH 43215
Ph: 614-487-1117 OH
Ph: 202-789-2900 DC
Internet: <https://www.americanhort.org/>

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 THE WALL AND CEILING INDUSTRY (AWCI)
513 West Broad Street, Suite 210
Falls Church, VA 22046
Ph: 703-538-1600
Fax: 703-534-8307
Internet: <https://www.awci.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 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>

CHEMICAL FABRICS AND FILM ASSOCIATION (CFFA)
1300 Sumner Avenue
Cleveland OH 44115-2851
Ph: 216-241-7333
Fax: 216-241-0105
E-mail: cffa@chemicalfabricsandfilm.com

Internet: <https://www.chemicalfabricsandfilm.com/>

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/>

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/>

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>

ELECTROSTATIC DISCHARGE ASSOCIATION (ESD)

7900 Turin Road, Building 3

Rome, NY 13440-2069

Ph: 315-339-6937

Fax: 315-339-6793

E-mail: info@esda.org

<https://www.esda.org/>

ETL TESTING LABORATORIES (ETL)

Intertek

Ph: 800-967-5352

Internet: <http://www.intertek.com/>

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 Bruxelles
Belgium
Ph: +32 2 299 96 96
Internet: https://ec.europa.eu/info/index_en

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
Vienna, VA 22182
Ph: 866-342-5642

Ph: 703-442-4890
Fax: 703-442-0630
Internet: <http://www.glasswebsite.com>

GREEN BUSINESS CERTIFICATION INC. (GBCI)
Washington, D.C.
Ph: 1-800-795-1747
Internet: <https://www.gbci.org>

GREEN SEAL (GS)
1001 Connecticut Avenue, NW
Suite 827
Washington, DC 20036-5525
Ph: 202-872-6400
Fax: 202-872-4324
E-mail: green SEAL@green SEAL.org
Internet: <https://www.green SEAL.org/>

GYPSUM ASSOCIATION (GA)
962 Wayne Ave., Suite 620
Silver Spring, MD 20910
Ph: 301-277-8686
Fax: 301-277-8747
E-mail: info@gypsum.org
Internet: <https://www.gypsum.org/>

HYDRAULIC INSTITUTE (HI)
6 Campus Drive, First Floor North
Parsippany, NJ 07054-4405
Ph: 973-267-9700
Fax: 973-267-9055
Internet: <http://www.pumps.org>

HYDRONICS INSTITUTE DIVISION OF AHRI (HYI)
2311 Wilson Blvd, Suite 400
Arlington, VA 22201
Ph: 703-524-8800
Internet: <http://www.ahrinet.org>

ICC EVALUATION SERVICE, INC. (ICC-ES)
3060 Saturn Street, Suite 100
Brea, CA 92821
Ph: 800-423-6587
Fax: 562-695-4694
E-mail: es@icc-es.org
Internet: <https://icc-es.org/>

ILLUMINATING ENGINEERING SOCIETY (IES)
120 Wall Street, Floor 17
New York, NY 10005-4001
Ph: 212-248-5000
Fax: 212-248-5018
E-mail: membership@ies.org
Internet: <https://www.ies.org/>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
445 and 501 Hoes Lane
Piscataway, NJ 08854-4141
Ph: 732-981-0060 or 800-701-4333

Fax: 732-981-9667
E-mail: onlinesupport@ieee.org
Internet: <https://www.ieee.org/>

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)
P.O. Box 493
Miamitown, OH 45041-9998
E-mail: info@icea.net
Internet: <https://www.icea.net/>

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)
27 N. Wacker Dr. Suite 365
Chicago, IL 60606-2800
Ph: 613-233-1510
Fax: 613-482-9436
E-mail: enquiries@igmaonline.org
Internet: <https://www.igmaonline.org/>

INTELLIGENCE COMMUNITY STANDARD (ICS)
Homeland Security Digital Library
Ph: 831-272-2437
E-mail: hsdl@nps.edu
Internet: <https://www.hsdl.org/c/>

INTERNATIONAL CAST POLYMER ASSOCIATION (ICPA)
4949 Old Brownsboro Rd, Ste. 232
Louisville, KY 40222
Ph: 470-219-8139
Internet: <https://theicpa.com/>

INTERNATIONAL CODE COUNCIL (ICC)
500 New Jersey Avenue, NW
6th Floor, Washington, DC 20001
Ph: 800-786-4452 or 888-422-7233
Fax: 202-783-2348
E-mail: order@iccsafe.org
Internet: <https://www.iccsafe.org/>

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)
1000 Westgate Drive, Suite 252
St. Paul, MN 55114
Ph: 651-366-6095
Fax: 651-290-2266
E-mail: info@icri.org
Internet: <https://www.icri.org/>

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)
3050 Old Centre Ave. Suite 101
Portage, MI 49024
Ph: 269-488-6382
Fax: 269-488-6383
Internet: <https://www.netaworld.org/>

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)
3, rue de Varembe, 1st floor
P.O. Box 131
CH-1211 Geneva 20, Switzerland
Ph: 41-22-919-02-11
Fax: 41-22-919-03-00

E-mail: info@iec.ch
Internet: <https://www.iec.ch/>

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
ISO Central Secretariat
BIBC II
Chemin de Blandonnet 8
CP 401 - 1214 Vernier, Geneva
Switzerland
Ph: 41-22-749-01-11
E-mail: central@iso.ch
Internet: <https://www.iso.org>

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)
1901 North Moore Street
Arlington, VA 22209-1762
Ph: 703-525-1695
Fax: 703-528-2148
Internet: <https://safetyequipment.org/>

INTERNET ENGINEERING TASK FORCE (IETF)
c/o Association Management Solutions, LLC (AMS)
5177 Brandin Court
Fremont, California 94538
Ph: 510-492-4080
Fax: 510-492-4001
E-mail: ietf-info@ietf.org
Internet: <https://www.ietf.org/>

L.H. BAILEY HORTORIUM (LHBH)
Plant Biology Units
The L.H. Bailey Hortorium and Herbarium
440 Mann Library Building
Ithaca, NY 14853
Ph: 607-255-1052
Fax: 607-254-5407
Internet: <https://plantbio.cals.cornell.edu/hortorium/>

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)
127 Park Street, NE
Vienna, VA 22180-4602
Ph: 703-281-6613
E-mail: info@msshq.org
Internet: <http://msshq.org>

MARBLE INSTITUTE OF AMERICA (MIA)
Natural Stone Institute
380 E. Lorain Street
Oberlin, OH 44074
Ph: 440-250-9222
Fax: 440-774-9222
E-mail: info@naturalstoneinstitute.org
Internet: <https://www.naturalstoneinstitute.org/>

MASTER PAINTERS INSTITUTE (MPI)
2800 Ingleton Avenue
Burnaby, BC CANADA V5C 6G7
Ph: 1-888-674-8937

Fax: 1-888-211-8708
E-mail: info@paintinfo.com or techservices@mpi.net
Internet: <http://www.mpi.net/>

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)
16712 Elm Circle
Omaha, NE 68130
Ph: 402-342-3463 or 800-747-6422
Fax: 402-330-9702
Internet: <https://www.micainsulation.org/>

MODBUS ORGANIZATION, INC (MODBUS)
PO Box 628
Hopkinton, MA 01748
Ph: 508-435-7170
Fax: 508-435-7172
Internet: <http://www.modbus.org>

NACE INTERNATIONAL (NACE)
15835 Park Ten Place
Houston, TX 77084
Ph: 281-228-6200
Fax: 281-228-6300
E-mail: firstservice@nace.org
Internet: <https://www.nace.org>

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)
800 Roosevelt Road, Bldg C, Suite 312
Glen Ellyn, IL 60137
Ph: 630-942-6591
Fax: 630-790-3095
E-mail: info@naamm.org
Internet: <http://www.naamm.org>

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)
3 Bethesda Metro Center, Suite 1100
Bethesda, MD 20814
Ph: 301-657-3110
Fax: 301-215-4500
Internet: <https://www.necanet.org/>

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)
1300 North 17th Street, Suite 900
Arlington, VA 22209
Ph: 703-841-3200
Internet: <https://www.nema.org>

NATIONAL ELEVATOR INDUSTRY, INC. (NEII)
5003 Westfield Blvd.
P.O. Box 231137
Centreville, VA 20120
Ph: 703-589-9985
E-Mail: info@neii.org
Internet: <http://www.neii.org>

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)
8575 Grovemont Circle
Gaithersburg, MD 20877
Ph: 301-977-3698

Fax: 301-977-9589
Internet: <http://www.nebb.org>

NATIONAL FENESTRATION RATING COUNCIL (NFRC)
6305 Ivy Lane, Suite 140
Greenbelt, MD 20770
Ph: 301-589-1776
Fax: 301-589-3884
E-Mail: info@nfrf.org
Internet: <http://www.nfrf.org>

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
1 Batterymarch Park
Quincy, MA 02169-7471
Ph: 800-344-3555
Fax: 800-593-6372
Internet: <https://www.nfpa.org>

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)
6830 Raleigh LaGrange Road
PO Box 34518
Memphis, TN 38184
Ph: 901-377-1818
Internet: <https://nhla.com/>

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES
(NICET)
1420 King Street
Alexandria, VA 22314-2794
Ph: 888-476-4238 (1-888 IS-NICET)
E-mail: tech@nicet.org
Internet: <https://www.nicet.org/>

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)
Patriots Plaza 1
395 E Street, SW, Suite 9200
Washington, DC 20201
Ph: 800-232-4636
Fax: 513-533-8347
Internet: <https://www.cdc.gov/niosh/>

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)
100 Bureau Drive
Gaithersburg, MD 20899
Ph: 301-975-2000
Internet: <https://www.nist.gov/>

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)
10255 West Higgins Road, Suite 600
Rosemont, IL 60018-5607
Ph: 847-299-9070
Fax: 847-299-1183
Internet: <http://www.nrca.net>

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)
272 Tuttle Road
Cumberland, ME 04021
Ph: 207-829-6901
Fax: 207-829-4293

E-mail: info@nelma.org
Internet: <https://www.nelma.org/>

NSF INTERNATIONAL (NSF)
789 North Dixboro Road
P.O. Box 130140
Ann Arbor, MI 48105
Ph: 734-769-8010 or 800-NSF-MARK
Fax: 734-769-0109
E-mail: info@nsf.org
Internet: <http://www.nsf.org>

OPC FOUNDATION (OPC)
16101 N. 82nd Street
Suite 3B
Scottsdale, AZ 85260-1868
Ph: 480-483-6644
Fax: 480-483-7202
Internet: <https://opcfoundation.org/>

OPEN NETWORK VIDEO INTERFACE FORUM (ONVIF)
2400 Camino Ramon, Suite 375
San Ramon, CA 94583
Ph: 925-275-6621
Fax: 925-275-6691
Internet: <https://www.onvif.org/>

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)
2, rue Andre Pascal
75775 Paris Cedex 16, France
Ph: + 33 1 45 24 82 00
Fax: 33 1 45 24 85 00
Internet: <http://www.oecd.org>
U.S. Contact Center
OECD Washington Center
1776 I Street, NW, Suite 450
Washington, DC 20006
Ph: 202-785-6323
E-mail: washington.contact@oecd.org

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)
800 Roosevelt Road
Building C, Suite 312
Glen Ellyn, IL 60137
Ph: 630-858-6540
Fax: 630-790-3095
Internet: <https://www.ppfahome.org/>

PLUMBING AND DRAINAGE INSTITUTE (PDI)
800 Turnpike Street, Suite 300
North Andover, MA 01845
Ph: 978-557-0720 or 800-589-8956
E-Mail: pdi@PDIONline.org
Internet: <http://www.pdionline.org>

PORCELAIN ENAMEL INSTITUTE (PEI)
PO Box 920220
Norcross, GA 30010
Ph: 770-676-9366

Fax: 770-409-7280
E-mail: penamel@aol.com
Internet: <http://www.porcelainenamel.com>

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)
10, Route de l'Aéroport
Case Postale 638
1215 Geneva - Switzerland
Ph: +41 (22) 799-4540
Fax: +41 (22) 799-4550
Internet: <https://www.pefc.org/>

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD
ASSOCIATION (CRA)
818 Grayson Road, Suite 201
Pleasant Hill, CA 94523
Ph: 925-935-1499
Fax: 925-935-1496
Internet:
<https://www.wvpa.org/about-wvpa/redwood-inspection-service>

RESILIENT FLOOR COVERING INSTITUTE (RFCI)
115 Broad Street
Suite 201
LaGrange, Georgia 30240
Internet: <https://rfci.com/>

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)
2000 Powell Street, Suite 600
Emeryville, CA 94608
Ph: 510-452-8000
Fax: 510-452-8001
E-mail: info@SCSglobalservices.com
Internet: <https://www.scsglobalservices.com/>

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1219
Ph: 703-803-2980
Fax: 703-803-3732
Internet: <https://www.smacna.org/>

SOCIETY FOR PROTECTIVE COATINGS (SSPC)
800 Trumbull Drive
Pittsburgh, PA 15205
Ph: 877-281-7772 or 412-281-2331
Fax: 412-444-3591
E-mail: customerservice@sspc.org
Internet: <http://www.sspc.org>

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)
400 Commonwealth Drive
Warrendale, PA 15096
Ph: 877-606-7323 or 724-776-4841
Fax: 724-776-0790
E-mail: customerservice@sae.org
Internet: <https://www.sae.org/>

SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS (SCTE)
140 Philips Road
Exton, PA 19341-1318
Ph: 800-542-5040 or 610-363-6888
Fax: 610-884-7237
E-Mail: info@scte.org
Internet: <https://www.scte.org/>

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)
21865 Copley Drive
Diamond Bar, CA 91765
Ph: 909-396-2000
E-mail: webinquiry@aqmd.gov
Internet: <http://www.aqmd.gov>

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)
665 Rodi Road, Suite 305
Pittsburgh, PA 15235
Ph: 412-244-0440
Fax: 412-244-9090
Internet: <http://www.cypressinfo.org>

SOUTHERN PINE INSPECTION BUREAU (SPIB)
P.O. Box 10915
Pensacola, FL 32524-0915
Ph: 850-434-2611 or 800-995-7742
Fax: 850-434-1290
E-mail: spib@spib.org
Internet: <https://www.spib.org/>

STATE OF CALIFORNIA DEPARTMENT OF CONSUMER AFFAIRS, BUREAU OF
ELECTRICAL AND APPLIANCE REPAIR, HOME FURNISHINGS AND THERMAL
INSULATION (BEARHFTI)
4244 South Market Court, Suite D
Sacramento, CA 95834-1243
Ph: 916-999-2041
Fax: 916-921-7279
E-mail: HomeProducts@dca.ca.gov
Internet: <https://www.bearhfti.ca.gov/>

STEEL DECK INSTITUTE (SDI)
P.O. Box 426
Glenshaw, PA 15116
Ph: 412-487-3325
Fax: 412-487-3326
Internet: <https://www.sdi.org/>

STEEL DOOR INSTITUTE (SDI/DOOR)
30200 Detroit Road
Westlake, OH 44145
Ph: 440-899-0010
Fax: 440-892-1404
E-mail: info@steeldoors.org
Internet: <https://www.steeldoors.org/>

SUSTAINABLE FOREST INITIATIVE (SFI)
2121 K Street NW
Suite 750
Washington, DC 20037

Ph: 202-596-3450
Fax: 202-596-3451
E-mail: info@sfiprogram.org
Internet: <http://www.sfiprogram.org>

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
1320 North Courthouse Road, Suite 200
Arlington, VA 22201
Ph: 703-907-7700
Fax: 703-907-7727
E-mail: marketing@tiaonline.org
Internet: <https://www.tiaonline.org/>

THE MASONRY SOCIETY (TMS)
105 South Sunset Street, Suite Q
Longmont, CO 80501-6172
Ph: 303-939-9700
Fax: 303-541-9215
E-mail: info@masonrysociety.org
<https://masonrysociety.org/>

TILE COUNCIL OF NORTH AMERICA (TCNA)
100 Clemson Research Boulevard
Anderson, SC 29625
Ph: 864-646-8453
Fax: 864-646-2821
E-mail: info@tileusa.com
Internet: <https://www.tcnatile.com/>

TREE CARE INDUSTRY ASSOCIATION (TCIA)
136 Harvey Road, Suite 101
Londonderry, NH 03053
Ph: 603-314-5380 or 800-733-2622
Fax: 603-314-5386
Internet: <https://tcia.org/>

U.S. ARMY CORPS OF ENGINEERS (USACE)
CRD-C DOCUMENTS available on Internet:
<http://www.wbdg.org/ffc/army-coe/standards>
Order Other Documents from:
Official Publications of the Headquarters, USACE
E-mail: hqpublications@usace.army.mil
Internet: <http://www.publications.usace.army.mil/>
or
<https://www.hnc.usace.army.mil/Missions/Engineering-Directorate/TECHINFO/>

U.S. DEFENSE LOGISTICS AGENCY (DLA)
Andrew T. McNamara Building
8725 John J. Kingman Road
Fort Belvoir, VA 22060-6221
Ph: 877-352-2255
E-mail: dlacontactcenter@dla.mil
Internet: <http://www.dla.mil>

U.S. DEPARTMENT OF AGRICULTURE (USDA)
Order AMS Publications from:
AGRICULTURAL MARKETING SERVICE (AMS)
Seed Regulatory and Testing Branch
801 Summit Crossing Place, Suite C

Gastonia, NC 28054-2193
Ph: 704-810-8884
E-mail: PA@ams.usda.gov
Internet: <https://www.ams.usda.gov/>
Order Other Publications from:
USDA Rural Development
Rural Utilities Service
STOP 1510, Rm 5135
1400 Independence Avenue SW
Washington, DC 20250-1510
Phone: (202) 720-9540
Internet:
<https://www.rd.usda.gov/about-rd/agencies/rural-utilities-service>

U.S. DEPARTMENT OF DEFENSE (DOD)
Order DOD Documents from:
Room 3A750-The Pentagon
1400 Defense Pentagon
Washington, DC 20301-1400
Ph: 703-571-3343
Fax: 215-697-1462
E-mail: customerservice@ntis.gov
Internet: <https://www.ntis.gov/>
Obtain Military Specifications, Standards and Related Publications
from:
Acquisition Streamlining and Standardization Information System
(ASSIST)
Department of Defense Single Stock Point (DODSSP)
Document Automation and Production Service (DAPS)
Building 4/D
700 Robbins Avenue
Philadelphia, PA 19111-5094
Ph: 215-697-6396 - for account/password issues
Internet: <https://assist.dla.mil/online/start/>; account
registration required
Obtain Unified Facilities Criteria (UFC) from:
Whole Building Design Guide (WBDG)
National Institute of Building Sciences (NIBS)
1090 Vermont Avenue NW, Suite 700
Washington, DC 20005
Ph: 202-289-7800
Fax: 202-289-1092
Internet:
<https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc>

U.S. DEPARTMENT OF ENERGY (DOE)
1000 Independence Avenue Southwest
Washington, D.C. 20585
Ph: 202-586-5000
Fax: 202-586-4403
E-mail: The.Secretary@hq.doe.gov
Internet: <https://www.energy.gov/>

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)
1200 Pennsylvania Avenue, N.W.
Washington, DC 20004
Ph: 202-564-4700
Internet: <https://www.epa.gov>
--- Some EPA documents are available only from:

National Technical Information Service (NTIS)
5301 Shawnee Road
Alexandria, VA 22312
Ph: 703-605-6060 or 1-800-363-2068
Fax: 703-605-6880
TDD: 703-487-4639
E-mail: info@ntis.gov
Internet: <https://www.ntis.gov/>

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)
Order for sale documents from:
Superintendent of Documents
U.S. Government Publishing Office (GPO)
732 N. Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
Bookstore: 202-512-0132
Internet: <https://www.gpo.gov/>
Order free documents from:
U.S. Department of Transportation
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591
Ph: 866-835-5322
Internet: <https://www.faa.gov/>

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)
445 12th Street SW
Washington, DC 20554
Ph: 888-225-5322
TTY: 888-835-5322
Fax: 866-418-0232
Internet: <https://www.fcc.gov/>
Order Publications From:
Superintendent of Documents
U.S. Government Publishing Office (GPO)
732 N. Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
Bookstore: 202-512-0132
Internet: <https://www.gpo.gov/>

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)
1200 New Jersey Ave., SE
Washington, DC 20590
Ph: 202-366-4000
E-mail: ExecSecretariat.FHWA@dot.gov
Internet: <https://www.fhwa.dot.gov/>
Order from:
Superintendent of Documents
U.S. Government Publishing Office (GPO)
732 N. Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
Bookstore: 202-512-0132
Internet: <https://www.gpo.gov/>

U.S. GENERAL SERVICES ADMINISTRATION (GSA)
General Services Administration

1800 F Street, NW
Washington, DC 20405
Ph: 1-844-472-4111
Internet: <https://www.gsaelibrary.gsa.gov/ElibMain/home.do>
Obtain documents from:
Acquisition Streamlining and Standardization Information System
(ASSIST)
Internet: <https://assist.dla.mil/online/start/>; account
registration required

U. S. GREEN BUILDING COUNCIL (USGBC)
2101 L St NW, Suite 500
Washington, DC 20037
Ph: 202-828-7422
Internet: <https://new.usgbc.org/>

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
8601 Adelphi Road
College Park, MD 20740-6001
Ph: 866-272-6272
Internet: <https://www.archives.gov/>
Order documents from:
Superintendent of Documents
U.S. Government Publishing Office (GPO)
732 N. Capitol Street, NW
Washington, DC 20401
Ph: 202-512-1800 or 866-512-1800
Bookstore: 202-512-0132
Internet: <https://www.gpo.gov/>

UNDERWRITERS LABORATORIES (UL)
2600 N.W. Lake Road
Camas, WA 98607-8542
Ph: 877-854-3577 or 360-817-5500
E-mail: CustomerExperienceCenter@ul.com
Internet: <https://www.ul.com/>
UL Directories available through IHS at <https://ihsmarkit.com/>

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)
Corporate Headquarters
2711 LBJ Freeway, Suite 1000
Dallas, TX 75234
Ph: 972-243-3902
Fax: 972-243-3907
E-mail: info@uni-bell.org
Internet: <https://www.uni-bell.org/>

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION
(VISCMA)
994 Old Eagle School Road
Suite 1019
Wayne, PA 19087-1866
Ph: 610-971-4850
E-mail: info@viscma.com
Internet: <http://www.viscma.com>

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)
6980 S.W. Varns
Tigard, OR 97223

Ph: 503-639-0651
Fax: 503-684-8928
E-mail: info@wclib.org
Internet: <http://www.wclib.org>

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)
1500 SW First Ave., Suite 870
Portland, OR 97201
Ph: 503-224-3930
E-mail: info@wwpa.org
Internet: <http://www.wwpa.org>

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)
2025 M Street, NW, Suite 800
Washington, DC 20036-3309
Ph: 202-367-1157
or
330 N Wabash Avenue, Suite 2000
Chicago, IL 60611
Ph: 312-321-6802
E-mail: membersupport@wdma.com
Internet: <https://www.wdma.com/>

WOODWORK INSTITUTE (WI)
3188 Industrial Blvd.
West Sacramento, CA 95691
Ph: 916-372-9943
Fax: 916-372-9950
E-mail: info@woodinst.com
Internet: <https://woodworkinstitute.com>

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 45 00.00 10

QUALITY CONTROL

11/16, CHG 2: 11/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 PAYMENT
- 1.3 SUBMITTALS

PART 2 PRODUCTS

PART 3 EXECUTION

- 3.1 GENERAL REQUIREMENTS
- 3.2 CONTRACTOR QUALITY CONTROL (CQC) PLAN
 - 3.2.1 Content of the CQC Plan
 - 3.2.2 Acceptance of Plan
 - 3.2.3 Notification of Changes
- 3.3 COORDINATION MEETING
- 3.4 QUALITY CONTROL ORGANIZATION
 - 3.4.1 Personnel Requirements
 - 3.4.2 CQC System Manager
 - 3.4.3 CQC Personnel
 - 3.4.4 Assignment of CQC System Manager, Project Superintendent, and SSO Responsibilities
 - 3.4.5 Construction Quality Management Course- COVID-19 Restrictions
 - 3.4.6 Organizational Changes
- 3.5 SUBMITTALS AND DELIVERABLES
- 3.6 CONTROL
 - 3.6.1 Preparatory Phase
 - 3.6.2 Initial Phase
 - 3.6.3 Follow-up Phase
 - 3.6.4 Additional Preparatory and Initial Phases
- 3.7 TESTS
 - 3.7.1 Testing Procedure
 - 3.7.2 Testing Laboratories
 - 3.7.2.1 Capability Check
 - 3.7.2.2 Capability Recheck
 - 3.7.3 Onsite Laboratory
- 3.8 COMPLETION INSPECTION
 - 3.8.1 Punch-Out Inspection
 - 3.8.2 Pre-Final Inspection
 - 3.8.3 Final Acceptance Inspection
- 3.9 DOCUMENTATION
- 3.10 SAMPLE FORMS
- 3.11 NOTIFICATION OF NONCOMPLIANCE

-- End of Section Table of Contents --

SECTION 01 45 00.00 10

QUALITY CONTROL
11/16, 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 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" classifications; submittals not having a "G" classification are for information only. When used, a code following the "G" classifications 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 PROPOSAL EVALUATION. 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 written consent before making any substitution for these designated personnel.

Establish and maintain an effective quality control (QC) system that complies with FAR 52.246-12 "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 must 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 must maintain 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 15 calendar days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of FAR 52.246-12 "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.
- 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 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. Include personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly 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 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.

3.4.5 Construction Quality Management Course- COVID-19 Restrictions

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 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 FAR 52.211-10 "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 by 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 FAR 52.246-12 "Inspection of Construction".

3.9 DOCUMENTATION

Maintain current records providing factual evidence that required quality control activities and 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 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).

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 --

This page was intentionally left blank for duplex printing.

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	
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

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 45 00.15 10

RESIDENT MANAGEMENT SYSTEM CONTRACTOR MODE (RMS CM)

11/16

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 MEASUREMENT AND PAYMENT
- 1.3 CONTRACT ADMINISTRATION
 - 1.3.1 Correspondence and Electronic Communications
 - 1.3.2 Other Factors
- 1.4 RMS SOFTWARE
- 1.5 CONTRACT DATABASE - GOVERNMENT
- 1.6 CONTRACT DATABASE - CONTRACTOR
 - 1.6.1 Administration
 - 1.6.1.1 Contractor Information
 - 1.6.1.2 Subcontractor Information
 - 1.6.1.3 Correspondence
 - 1.6.1.4 Equipment
 - 1.6.1.5 Reports
 - 1.6.1.6 Request For Information (RFI)
 - 1.6.2 Finances
 - 1.6.2.1 Pay Activity Data
 - 1.6.2.2 Payment Requests
 - 1.6.3 Quality Control (QC)
 - 1.6.3.1 Quality Control (QC) Reports
 - 1.6.3.2 Deficiency Tracking.
 - 1.6.3.3 Three-Phase Control Meetings
 - 1.6.3.4 Labor and Equipment Hours
 - 1.6.3.5 Accident/Safety Reporting
 - 1.6.3.6 Definable Features of Work
 - 1.6.3.7 Activity Hazard Analysis
 - 1.6.4 Submittal Management
 - 1.6.5 Schedule
 - 1.6.6 Closeout
- 1.7 IMPLEMENTATION
- 1.8 NOTIFICATION OF NONCOMPLIANCE

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section Table of Contents --

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 --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 45 35

SPECIAL INSPECTIONS

11/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
- 1.3 DEFINITIONS
 - 1.3.1 Continuous Special Inspections
 - 1.3.2 Perform
 - 1.3.3 Observe
 - 1.3.4 Special Inspector (SI)
 - 1.3.5 Associate Special Inspector (ASI)
 - 1.3.6 Third Party
 - 1.3.7 Contracting Officer
 - 1.3.8 Contractor's Quality Control (QC) Manager
 - 1.3.9 Structural Engineer of Record (SER)
 - 1.3.10 Statement of Special Inspections (SSI)
 - 1.3.11 Schedule of Special Inspections (SSI)
 - 1.3.12 Definable Feature of Work (DFOW)
- 1.4 SUBMITTALS
- 1.5 SPECIAL INSPECTOR QUALIFICATIONS
 - 1.5.1 Steel Construction and High Strength Bolting
 - 1.5.1.1 Special Inspector
 - 1.5.1.2 Associate Special Inspector
 - 1.5.2 Welding Structural Steel
 - 1.5.2.1 Special Inspector
 - 1.5.2.2 Associate Special Inspector
 - 1.5.3 Nondestructive Testing of Welds
 - 1.5.3.1 Special Inspector
 - 1.5.3.2 Associate Special Inspector
 - 1.5.4 Cold Formed Steel Framing
 - 1.5.4.1 Special Inspector
 - 1.5.4.2 Associate Special Inspector
 - 1.5.5 Concrete Construction
 - 1.5.5.1 Special Inspector
 - 1.5.5.2 Associate Special Inspector
 - 1.5.6 Masonry Construction
 - 1.5.6.1 Special Inspector
 - 1.5.6.2 Associate Special Inspector
 - 1.5.7 Verification of Site Soil Condition, Fill Placement and Load-Bearing Requirements
 - 1.5.7.1 Special Inspector
 - 1.5.7.2 Associate Special Inspector
 - 1.5.8 Deep Foundations
 - 1.5.8.1 Special Inspector
 - 1.5.8.2 Associate Special Inspector
 - 1.5.9 Sprayed Fire Resistant Material
 - 1.5.9.1 Special Inspector

- 1.5.9.2 Associate Special Inspector
- 1.5.10 Mastic and Intumescent Fire Resistant Coatings
 - 1.5.10.1 Special Inspector
 - 1.5.10.2 Associate Special Inspector
- 1.5.11 Exterior Insulation and Finish System (EIFS)
 - 1.5.11.1 Special Inspector
 - 1.5.11.2 Associate Special Inspector
- 1.5.12 Fire-Resistant Penetrations and Joints
 - 1.5.12.1 Special Inspector
 - 1.5.12.2 Associate Special Inspector
- 1.5.13 Smoke Control
 - 1.5.13.1 Special Inspector
 - 1.5.13.2 Associate Special Inspector

PART 2 PRODUCTS

2.1 FABRICATOR SPECIAL INSPECTIONS

PART 3 EXECUTION

3.1 RESPONSIBILITIES

- 3.1.1 Quality Control Manager
 - 3.1.2 Special Inspectors
- ### 3.2 DEFECTIVE WORK

-- End of Section Table of Contents --

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.

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

1.2 GENERAL REQUIREMENTS

Perform Special Inspections in accordance with the Statement of Special Inspections, Schedule of Special Inspections and Chapter 17 of ICC IBC. The Statement of Special Inspections and Schedule of Special Inspections are included as an attachment to this specification. Special Inspections are to be performed by an independent third party and are intended to ensure that the work of the Prime Contractor is in accordance with the Contract Documents and applicable building codes. Special inspections do not take the place of the three phases of control inspections performed by the Contractor's QC Manager or any testing and inspections required by other sections of the specifications.

1.3 DEFINITIONS

1.3.1 Continuous Special Inspections

Continuous Special Inspections is the constant monitoring of specific tasks by a special inspector. These inspections must be carried out continuously over the duration of the particular tasks.

1.3.2 Perform

Perform these Special Inspections tasks for each welded joint or member.

1.3.3 Observe

Observe these Special Inspections items on a periodic daily basis. Operations need not be delayed pending these inspections.

1.3.4 Special Inspector (SI)

A qualified person retained by the Contractor and approved by the Contracting Officer as having the competence necessary to inspect a particular type of construction requiring Special Inspections. The SI must be an independent third party hired directly by the Prime Contractor.

1.3.5 Associate Special Inspector (ASI)

A qualified person who assists the SI in performing Special Inspections

but must perform inspection under the direct supervision of the SI and cannot perform inspections without the SI on site.

1.3.6 Third Party

A Special inspector must not be an employee of the Contractor or of any Sub-Contractor performing the work to be inspected.

1.3.7 Contracting Officer

The Government official having overall authority for administrative contracting actions. Certain contracting actions may be delegated to the Contracting Officer's Representative (COR).

1.3.8 Contractor's Quality Control (QC) Manager

An individual retained by the Prime Contractor and qualified in accordance with the Section 01 45 00.00 10 QUALITY CONTROL having the overall responsibility for the Contractor's QC organization.

1.3.9 Structural Engineer of Record (SER)

A registered design professional employed by the Government responsible for the overall design and review of submittal documents prepared by others. The SER is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws in the state in which the design professional works. The SER is also referred to as the Engineer of Record (EOR) in design code documents.

1.3.10 Statement of Special Inspections (SSI)

A document developed by the SER identifying the material, systems, components and work required to have Special Inspections. This statement is included at the end of this specification.

1.3.11 Schedule of Special Inspections (SSI)

A schedule which lists each of the required Special Inspections, the extent to which each Special Inspection is to be performed, and the required frequency for each in accordance with ICC IBC Chapter 17. This schedule is included at the end of this specification.

1.3.12 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-06 Test Reports

Special Inspections Daily Reports

Special Inspections Biweekly Reports

SD-07 Certificates

AISC Certified Steel Fabricator

Certificate of Compliance

Special Inspector Qualifications; G

SD-11 Closeout Submittals

Interim Report of Special Inspections for Each DFOG; G

Comprehensive Final Report of Special Inspections; G

1.5 SPECIAL INSPECTOR QUALIFICATIONS

Submit qualifications for each special inspector.

1.5.1 Steel Construction and High Strength Bolting

1.5.1.1 Special Inspector

- a. ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or
- b. Registered Professional Engineer with three years of related experience

1.5.1.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.2 Welding Structural Steel

1.5.2.1 Special Inspector

- a. ICC Structural Welding Special Inspector certificate with one year of related experience, or
- b. AWS Certified Welding Inspector

1.5.2.2 Associate Special Inspector

AWS Certified Associate Welding Inspector

1.5.3 Nondestructive Testing of Welds

1.5.3.1 Special Inspector

NDT Level III Certificate

1.5.3.2 Associate Special Inspector

NDT Level II Certificate plus one year of related experience

1.5.4 Cold Formed Steel Framing

1.5.4.1 Special Inspector

- a. ICC Structural Steel and Bolting Special Inspector certificate with one year of related experience, or
- b. ICC Commercial Building Inspector with one year of experience, or
- c. ICC Residential Building Inspector with one year of experience, or
- d. Registered Professional Engineer with three years related experience

1.5.4.2 Associate Special Inspector

Engineer-In-Training with one year of related experience.

1.5.5 Concrete Construction

1.5.5.1 Special Inspector

- a. ICC Reinforced Concrete Special Inspector Certificate with one year of related experience, or
- b. ACI Concrete Construction Special Inspector, or
- c. Registered Professional Engineer with three years of related experience

1.5.5.2 Associate Special Inspector

- a. ACI Concrete Construction Special Inspector in Training, or
- b. Engineer-In-Training with one year of related experience

1.5.6 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.

PART 2 PRODUCTS

2.1 FABRICATOR SPECIAL INSPECTIONS

Special Inspections of fabricator's work performed in the fabricator's shop is required to be inspected in accordance with the Statement of Special Inspections and the Schedule of Special Inspections unless the fabricator is certified by the approved agency to perform such work without Special Inspections. Submit the following certifications to the Contracting Officer for information to allow work performed in the fabricator's shop to not be subjected to Special Inspections.

AISC Certified Steel Fabricator.

At the completion of fabrication, submit a certificate of compliance, to be included with the comprehensive final report of Special Inspections, stating that the materials supplied and work performed by the fabricator are in accordance with the construction documents.

PART 3 EXECUTION

3.1 RESPONSIBILITIES

3.1.1 Quality Control Manager

- a. Supervise all Special Inspectors required by the Contract Documents and the IBC.
- b. Verify the qualifications of all of the Special Inspectors.
- c. Verify the qualifications of fabricators.
- d. Maintain a 3-ring binder for the Special Inspector's daily and biweekly reports. This file must be located in a conspicuous place in the project trailer/office to allow review by the Contracting Officer and the SER.
- e. Maintain a rework items list that includes discrepancies noted on the Special Inspectors daily report.

3.1.2 Special Inspectors

- a. Inspect all elements of the project for which the special inspector is qualified to inspect and are identified in the Schedule of Special Inspections.
- b. Attend preparatory phase meetings related to the Definable Feature of Work (DFOW) for which the special inspector is qualified to inspect.
- c. Submit a copy of the daily reports to the QC Manager.
- d. 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.
- e. 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 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.

- f. At the completion of each DFOW requiring Special Inspections, submit an interim report of Special Inspections that documents the Special Inspections completed for that DFOW. Identify the inspector responsible for each item inspected and corrections of all discrepancies noted in the daily reports. The interim report of Special Inspections must be signed, dated and indicate the certification of the special inspector qualifying them to conduct the inspection.
- 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.

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 --

SCHEDULE OF SPECIAL INSPECTIONS

Reference UFGS 01 45 35 for all requirements not noted as part of this schedule.

INSPECTION DEFINITIONS:

- PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and noted verification.
- OBSERVE:** Observe these items randomly during the course of each work day to insure that applicable requirements are being met. Operations need not be delayed pending these inspections at contractor's risk.
- DOCUMENT:** Document, with a report, that the work has been performed in accordance with the contract documents. This is in addition to any other reports required in the Special Inspections guide specification.
- CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

The Seismic Design Category for this project is: ☐ A, ☒ B, ☐ C, ☐ D, ☐ E, ☐ F (check appropriate box)

DESIGNER NOTES (delete this box after reviewing):

1. This schedule contains minimum requirements. Do not delete applicable inspection tasks unless notes in blue indicate it is acceptable to do so.
2. Blue text = designers notes. The designer must review and edit all blue text in this schedule prior to inserting this schedule into the special inspections spec (UFGS 01 45 35).
3. Check section boxes with ANY inspection tasks applicable to your project. You may choose to delete unchecked sections or leave them in the schedule unchecked.
4. Individual rows/tasks that are not applicable to the project may be left in the section, as the inspector can determine whether they occur/apply (e.g. metal trusses in the light gauge framing section for example).
5. Design discipline sections are color coded for easier reference by designers. This schedule does NOT need to be printed in color.
6. When finished editing, delete this note box and save this schedule as a PDF and insert into the project specifications (special inspections section).

STRUCTURAL - STEEL – WELDING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

STEEL INSPECTION <u>PRIOR TO WELDING</u> – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-1		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify that the welding procedures specification (WPS) is available	PERFORM	
2. Verify manufacturer certifications for welding consumables are available	PERFORM	
3. Verify material identification	PERFORM	Type and grade.
4. Welder Identification System	PERFORM	The fabricator or erector, as applicable, shall maintain a system by which a welder who has welded a joint or member can be identified. Stamps, if used, shall be the low-stress type.
5. Fit-up of groove welds (including joint geometry)	OBSERVE	<ul style="list-style-type: none"> ✓ Joint preparation ✓ Dimensions (alignment, root opening, root face, bevel) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location) ✓ Backing type and fit (if applicable)
6. Configuration and finish of access holes	OBSERVE	
7. Fit-up of fillet welds	OBSERVE	<ul style="list-style-type: none"> ✓ Dimensions (alignment, gaps at root) ✓ Cleanliness (condition of steel surfaces) ✓ Tacking (tack weld quality and location)
STEEL INSPECTION <u>DURING WELDING</u> – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-2		
TASK	INSPECTION TYPE	DESCRIPTION
8. Use of qualified welders	PERFORM	Welding by welders, welding operators, and tack welders who are qualified in conformance with requirements.
9. Control and handling of welding consumables	OBSERVE	<ul style="list-style-type: none"> ✓ Packaging ✓ Electrode atmospheric exposure control
10. No welding over cracked tack welds	OBSERVE	
11. Environmental conditions	OBSERVE	<ul style="list-style-type: none"> ✓ Wind speed within limits ✓ Precipitation and temperature
12. Welding Procedures Specification followed	OBSERVE	<ul style="list-style-type: none"> ✓ Settings on welding equipment ✓ Travel speed ✓ Selected welding materials ✓ Shielding gas type/flow rate ✓ Preheat applied ✓ Interpass temperature maintained (min./max.) ✓ Proper position (F, V, H, OH) ✓ Intermix of filler metals avoided
13. Welding techniques	OBSERVE	<ul style="list-style-type: none"> ✓ Interpass and final cleaning ✓ Each pass within profile limitations ✓ Each pass meets quality requirements

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – WELDING SECTION (CONTINUED)

STEEL INSPECTION AFTER WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.4-3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
14. Welds cleaned	OBSERVE	
15. Size, length, and location of all welds	PERFORM	Size, length, and location of all welds conform to the requirements of the detail drawings.
16. Welds meet visual acceptance criteria	PERFORM AND DOCUMENT	<ul style="list-style-type: none"> ✓ Crack prohibition ✓ Weld/base-metal fusion ✓ Crater cross section ✓ Weld profiles ✓ Weld size ✓ Undercut ✓ Porosity
17. Arc strikes	PERFORM	
18. k-area	PERFORM	When welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, visually inspect the web k-area for cracks.
19. Backing removed, weld tabs removed and finished, and fillet welds added where required	PERFORM	
20. Repair activities	PERFORM AND DOCUMENT	
21. Document acceptance or rejection of welded joint or member	PERFORM	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL – BOLTING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

STEEL INSPECTION TASKS PRIOR TO BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-1		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Manufacturer's certifications available for fastener materials	PERFORM	
2. Fasteners marked in accordance with ASTM requirements	OBSERVE	
3. Proper fasteners selected for joint detail (grade, type, bolt length if threads are to be excluded from shear plane)	OBSERVE	
4. Proper bolting procedure selected for joint detail	OBSERVE	
5. Connecting elements, including appropriate faying surface condition and hole preparation, if specified, meet applicable requirements	OBSERVE	
6. Proper storage provided for bolts, nuts, washers, and other fastener components	OBSERVE	
STEEL INSPECTION TASKS DURING BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table C-N5.6-2		
TASK	INSPECTION TYPE ¹	DESCRIPTION
7. Fastener assemblies of suitable condition, placed in all holes and washers (if required) are positioned as required	OBSERVE	
8. Joint brought to the snug-tight condition prior to pretensioning operation	OBSERVE	
9. Fastener component not turned by the wrench prevented from rotating	OBSERVE	
10. Bolts are pretensioned in accordance with RCSC Specification, progressing systematically from the most rigid point toward the free edges	OBSERVE	
STEEL INSPECTION TASKS AFTER BOLTING – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.1, AISC 360-10: Table C-N5.6-3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
11. Document acceptance or rejection of all bolted connections	DOCUMENT	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - NON DESTRUCTIVE TESTING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Section N5.5		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Use of qualified nondestructive testing personnel	PERFORM	Visual weld inspection and nondestructive testing (NDT) shall be conducted by personnel qualified in accordance with AWS D1.8 clause 7.2
2. CJP groove welds	OBSERVE	{NOTE: DOR must delete this row if section D (SEISMIC PROVISIONS SECTION) is checked} Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 20% of CJP groove welds for materials greater than 5/16" (8mm) thick. Testing rate must be increased to 100% if greater than 5% of welds tested have unacceptable defects.
3. Welded joints subject to fatigue	OBSERVE	Dye penetrant testing (DT) and Ultrasonic testing (UT) shall be performed on 100% of welded joints identified on contract drawings as being subject to fatigue.
4. Weld tab removal sites	OBSERVE	At the end of welds where weld tabs have been removed, magnetic particle testing shall be performed on the same beam-to-column joints receiving UT

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - STEEL – AISC 341 REQUIREMENTS (SEISMIC PROVISIONS) SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐ ☒**

NONDESTRUCTIVE TESTING OF WELDED JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Section J6.2		
TASK	INSPECTION TYPE ¹	DESCRIPTION
[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]		
5. CJP groove welds	OBSERVE	Dye penetrant testing (DT) and ultrasonic testing (UT) shall be performed on 100% of CJP groove welds for materials greater than 5/16" thick (8mm).
6. Beam cope and access hole.	OBSERVE	At welded splices and connections, thermally cut surfaces of beam copes and access holes shall be tested using magnetic particle testing (MT) or dye penetrant testing (DT), when the flange thickness exceeds 1 1/2 in. for rolled shapes, or when the web thickness exceeds 1 1/2 in. for built-up shapes.
7. K-area NDT (AISC 341)	PERFORM	Where welding of doubler plates, continuity plates or stiffeners has been performed in the k-area, the web shall be tested for cracks using magnetic particle testing (MT). The MT inspection area shall include the k-area base metal within 3-inches of the weld. The MT shall be performed no sooner than 48 hours following completion of the welding.
8. Placement of reinforcing or contouring fillet welds	DOCUMENT	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - STEEL - COMPOSITE CONSTRUCTION ¹**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

COMPOSITE CONSTRUCTION PRIOR TO PLACING CONCRETE – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 360-16: Table N6.1, AISC 341-16: Table J9.1		
TASK	INSPECTION TYPE ²	DESCRIPTION
1. Placement and installation of steel headed stud anchors	PERFORM	
2. Material identification of reinforcing steel (Type/Grade)	OBSERVE	
3. Determination of carbon equivalent for reinforcing steel other than ASTM A706	OBSERVE	
4. Proper reinforcing steel size, spacing, clearances, support, and orientation	OBSERVE	
5. Reinforcing steel has not been re-bent in the field	OBSERVE	
6. Reinforcing clearances have been provided	OBSERVE	
7. Reinforcing steel has been tied and supported as required	OBSERVE	
8. Composite member has required size	OBSERVE	

END SECTION**STRUCTURAL - STEEL - OTHER INSPECTIONS****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

OTHER STEEL INSPECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.2.1, AISC 341-16: Tables J8.1 & J10.1		
TASK	INSPECTION TYPE ²	DESCRIPTION
1. Anchor rods and other embedments supporting structural steel	PERFORM	Verify the diameter, grade, type, and length of the anchor rod or embedded item, and the extent or depth of embedment prior to placement of concrete.
2. Fabricated steel or erected steel frame	OBSERVE	Verify compliance with the details shown on the construction documents, such as braces, stiffeners, member locations and proper application of joint details at each connection.
3. Reduced beam sections (RBS) where/if occurs	DOCUMENT	✓ Contour and finish ✓ Dimensional tolerances
4. Protected zones	DOCUMENT	No holes or unapproved attachments made by fabricator or erector
5. H-piles where/if occurs	DOCUMENT	No holes or unapproved attachments made by the responsible contractor

END SECTION¹ See Concrete Construction Section for all concrete related inspection of composite steel construction.

² **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK - PLACEMENT SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

METAL DECK INSPECTION <u>PRIOR TO</u> DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.1		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify compliance of materials (deck and all deck accessories) with construction documents, including profiles, material properties, and base metal thickness	PERFORM	
2. Document acceptance or rejection of deck and deck accessories	DOCUMENT	
METAL DECK INSPECTION <u>DURING</u> DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.2		
TASK	INSPECTION TYPE ¹	DESCRIPTION
3. Verify compliance of deck and all deck accessories installation with construction documents	PERFORM	
4. Verify deck materials are represented by the mill certifications that comply with the construction documents	PERFORM	
5. Document acceptance or rejection of installation of deck and deck accessories	DOCUMENT	
METAL DECK INSPECTION <u>AFTER</u> DECK PLACEMENT – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
6. Welding procedure specification (WPS) available	PERFORM	
7. Manufacturers certifications for welding consumables available	OBSERVE	
8. Material identification (type/grade)	OBSERVE	
9. Check welding equipment	OBSERVE	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – WELDING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

METAL DECK INSPECTION <u>DURING</u> WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.4		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Use of qualified welders	OBSERVE	
2. Control and handling of welding consumables	OBSERVE	
3. Environmental conditions (wind speed, moisture, temperature)	OBSERVE	
4. WPS followed	OBSERVE	
METAL DECK INSPECTION <u>AFTER</u> WELDING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.5		
TASK	INSPECTION TYPE ¹	DESCRIPTION
5. Verify size and location of welds, including support, sidelap, and perimeter welds.	PERFORM	
6. Welds meet visual acceptance criteria	PERFORM	
7. Verify repair activities	PERFORM	
8. Document acceptance or rejection of welds	DOCUMENT	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - COLD-FORMED METAL DECK – FASTENING SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

METAL DECK INSPECTION <u>BEFORE</u> MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.6		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Manufacturer installation instructions available for mechanical fasteners	OBSERVE	
2. Proper tools available for fastener installation	OBSERVE	
METAL DECK INSPECTION <u>DURING</u> MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.7		
TASK	INSPECTION TYPE ¹	DESCRIPTION
3. Fasteners are positioned as required	OBSERVE	
4. Fasteners are installed in accordance with manufacturer's instructions	OBSERVE	
METAL DECK INSPECTION <u>AFTER</u> MECHANICAL FASTENING – VERIFY THE FOLLOWING ARE IN COMPLIANCE SDI QA/QC-2011, Appendix 1, Table 1.8		
TASK	INSPECTION TYPE ¹	DESCRIPTION
5. Check spacing, type, and installation of support fasteners	PERFORM	
6. Check spacing, type, and installation of sidelap fasteners	PERFORM	
7. Check spacing, type, and installation of perimeter fasteners	PERFORM	
8. Verify repair activities	PERFORM	
9. Document acceptance or rejection of mechanical fasteners	DOCUMENT	

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.
OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.
DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

STRUCTURAL - LIGHT GAUGE STEEL FRAMING AND/OR LIGHT GAUGE TRUSSES SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐ ☒

LIGHT GAUGE STEEL CONSTRUCTION AND CONNECTIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.2.2, 1705.11.2, 1705.11.3, UFC 4 023 03		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Trusses spanning 60-feet or greater where/if applies	PERFORM	Verify that temporary and permanent truss restraint/bracing is installed in accordance with approved truss submittal package.
2. Welded connections (seismic and/or wind resisting system)	OBSERVE	Visually inspect all welds composing part of the main wind or seismic force resisting system, including shearwalls, braces, collectors (drag struts), and hold-downs. [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. [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). [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 IBC TABLE 1705.2.3		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Installation of open-web steel joists and joist girders	OBSERVE	<ul style="list-style-type: none"> ✓ End connections – welded or bolted ✓ Bridging – horizontal and diagonal

END SECTION

¹ **PERFORM:** Perform these tasks for each weld, fastener or bolted connection, and required verification.

OBSERVE: Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

STRUCTURAL - CONCRETE CONSTRUCTION SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspect reinforcement, including prestressing tendons, and verify placement.	OBSERVE	Verify prior to placing concrete that reinforcing is of specified type, grade and size; that it is free of oil, dirt and unacceptable rust; that it is located and spaced properly; that hooks, bends, ties, stirrups and supplemental reinforcement are placed correctly; that lap lengths, stagger and offsets are provided; and that all mechanical connections are installed per the manufacturer's instructions and/or evaluation report.
2. Reinforcing bar welding	OBSERVE	✓ Verify weldability of reinforcing bars other than ASTM A 706 ✓ Inspect single-pass fillet welds, maximum 5/16" in accordance with AWS D1.4
3. All other welding	CONTINUOUS	Visually inspect all welds in accordance with AWS D1.4
4. Cast in place anchors and post installed drilled anchors (downward inclined)	OBSERVE	Verify prior to placing concrete that cast in place anchors and post installed drilled anchors have proper embedment, spacing and edge distance.
5. Post-installed adhesive anchors in horizontal or upward inclined orientations	CONTINUOUS AND DOCUMENT	✓ Inspect as required per approved ICC-ES report ✓ Verify that installer is certified for installation of horizontal and overhead installation applications ✓ Inspect proof loading as required by the contract documents
6. Verify use of required mix design	OBSERVE	Verify that all mixes used comply with the approved construction documents
7. Prior to concrete placement, fabricate specimens for strength tests, perform slump and air content tests, and determine the temperature of the concrete	CONTINUOUS	At the time fresh concrete is sampled to fabricate specimens for strength test verify these tests are performed by qualified technicians.
8. Inspect concrete and/or shotcrete placement for proper application techniques	CONTINUOUS	Verify proper application techniques are used during concrete conveyance and depositing avoids segregation or contamination. Verify that concrete is properly consolidated.
9. Verify maintenance of specified curing temperature and technique	OBSERVE	Inspect curing, cold weather protection, and hot weather protection procedures.
10. Pre-stressed concrete	CONTINUOUS	Verify application of prestressing forces and grouting of bonded prestressing tendons.

CONTINUED ON FOLLOWING PAGE

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - CONCRETE CONSTRUCTION (CONTINUED)

CONCRETE CONSTRUCTION, INCLUDING COMPOSITE DECK – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC TABLE 1705.3 (ACI 318 REFERENCES NOTED IN IBC TABLE)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
11. Inspect erection of precast concrete members	OBSERVE	
12. Verify in-situ concrete strength, prior to stressing of tendons in post-tensioned concrete and prior to removal of shores and forms from beams and structural slabs.	OBSERVE	
13. Inspect formwork for shape, location and dimensions of the concrete member being formed.	OBSERVE	

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

DOCUMENT: Document in a report that the work has been performed as required. This is in addition to all other required reports.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - MASONRY CONSTRUCTION SECTION (ALL RISK CATEGORIES)**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE <u>AT START</u> OF CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Compliance with approved submittals prior to start	OBSERVE	
2. Proportions of site-mixed mortar.	OBSERVE	
3. Grade and type of reinforcement, anchor bolts, and prestressing tendons and anchorages	OBSERVE	
4. Prestressing technique	OBSERVE	
5. Properties of thin bed mortar for AAC masonry	OBSERVE	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE <u>PRIOR TO</u> GROUTING IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
6. Grout space	OBSERVE CONTINUOUS	{NOTE: DOR must either delete 'OBSERVE' for Risk Category IV/V, or delete 'CONTINUOUS' for Risk Categories I/II/III}
7. Proportions of site-prepared grout and prestressing grout for bonded tendons	OBSERVE	
8. Proportions of site-mixed grout and prestressing grout for bonded tendons	OBSERVE	
9. Placement of masonry units and mortar joints	OBSERVE	
10. Welding of reinforcement	CONTINUOUS	
MASONRY CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE <u>DURING</u> CONSTRUCTION IBC 1705.4 (ACI 530-13 TABLE 3.1.2 & 3.1.3)		
TASK	INSPECTION TYPE ¹	DESCRIPTION
11. Size and location of structural elements is in compliance	OBSERVE	
12. Preparation, construction, and protection of masonry during cold weather (temperature below 40°F (4.4°C) or hot weather (temp above 90°F (32.2°C))	OBSERVE	
13. Application and measurement of prestressing force	CONTINUOUS	
14. Placement of grout and prestressing grout for bonded tendons	CONTINUOUS	
15. Placement of AAC masonry units and construction of thin bed mortar joints	CONTINUOUS	Continuous for first 5000 square feet only (465 square meters).
16. Observe preparation of grout specimens, mortar specimens, and/or prisms	OBSERVE	
17. Type, size and placement of reinforcement, connectors, anchor bolts and prestressing tendons and anchorages, including details of anchorage of masonry to structural members, frames, or other construction	OBSERVE CONTINUOUS	{NOTE: DOR must either delete 'OBSERVE' for Risk Category IV/V, or delete 'CONTINUOUS' for Risk Categories I/II/III}

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

STRUCTURAL - WOOD CONSTRUCTION – SPECIALTY ITEMS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐ ☒

WOOD CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.5		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. High-load diaphragms where applicable	OBSERVE	Verify thickness and grade of sheathing, size of framing members at panel edges, nail diameters and length, and the number of fastener lines and that fastener spacing is per approved contract documents.
2. Metal-plate connected wood trusses spanning 60 feet or greater	OBSERVE	Verify that the temporary installation restraint/bracing and the permanent individual truss member restraint/bracing are installed in accordance with the approved truss submittal package

END SECTION**STRUCTURAL - WOOD CONSTRUCTION - SEISMIC & WIND SECTION****THIS SECTION IS APPLICABLE IF BOX IS CHECKED:** ☐ ☒

WOOD CONSTRUCTION SEISMIC AND WIND – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.11 & 1705.12.2		
TASK	INSPECTION TYPE ¹	DESCRIPTION
{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 2018 IBC TABLE 1705.12.8		
{NOTE: This section is not 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 IBC 1705.6		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Materials below shallow foundations are adequate to achieve the design bearing capacity.	OBSERVE	
2. Excavations are extended to proper depth and have reached proper material	OBSERVE	
3. Perform classification and testing of compacted fill materials	OBSERVE	
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill	CONTINUOUS	
5. Prior to placement of compacted fill, inspect subgrade and verify that site has been prepared properly.	OBSERVE	During fill placement, the special inspector shall verify that proper materials and procedures are used in accordance with the provisions of the approved geotechnical report

END SECTION**GEOTECHNICAL - DRIVEN DEEP FOUNDATION ELEMENTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐ ☒**

DEEP DRIVEN FOUNDATION CONSTRUCTION – VERIFY THE FOLLOWING ARE IN COMPLIANCE IBC 1705.7		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify element materials, sizes and lengths comply with requirements	CONTINUOUS	
2. Inspect driving operations and maintain complete and accurate records for each element	CONTINUOUS	
3. Verify placement locations and plumbness, confirm type and size of hammer, record number of blows per foot of penetration, determine required penetrations to achieve design capacity, record tip and butt elevations and document any damage to foundation element	CONTINUOUS	
4. Determine capacities of test elements and conduct additional load tests if required.	CONTINUOUS	
5. For steel or concrete elements, perform additional special inspections in accordance with the Steel and Concrete sections in this schedule		

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

CONTINUOUS: Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

GEOTECHNICAL - HELICAL PILE FOUNDATIONS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐ ☒

HELICAL PILE FOUNDATIONS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.9		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Record installation equipment used, pile dimensions, tip elevations, final depth, final installation torque and other pertinent installation data as required. The approved geotechnical report and the contract documents shall be used to determine compliance	CONTINUOUS	

END SECTION**GEOTECHNICAL - CAST IN PLACE DEEP FOUNDATION ELEMENTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☒

CAST IN PLACE DEEP FOUNDATION ELEMENTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.8		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspect drilling operations and maintain complete and accurate records for each element.	CONTINUOUS	
2. Verify placement locations and plumbness, confirm element diameters, bell diameters (if applicable), lengths, embedment into bedrock (if applicable) and adequate end-bearing strata capacity. Record concrete or grout volumes	CONTINUOUS	For concrete elements, perform additional special inspections in accordance with the Concrete section in this schedule

END SECTION

¹ **CONTINUOUS:** Constant monitoring of identified tasks by a special inspector over the duration of performance of said tasks.

FIRE PROTECTION - SPRAYED FIRE-RESISTANT MATERIALS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐ ☒

SPRAYED FIRE RESISTANT MATERIALS (SFRM) – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.14

TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Substrate condition	OBSERVE	Prior to application, confirm that surfaces have been prepared according to the approved fire-resistance design and manufacturer's instructions.
2. Material thickness	OBSERVE	Verify SFRM thickness according to 2018 IBC 1705.14.4
3. Material density	OBSERVE	Verify SFRM density according to 2018 IBC 1705.14.5
4. Bond strength	OBSERVE	Verify bond strength of cured SFRM according to IBC 1705.14.6

END SECTION**FIRE PROTECTION - MASTIC AND INTUMESCENT COATINGS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐ ☒

MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.15

TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspect according to AWCI 12-B and the contract documents	OBSERVE	Inspections shall be performed in accordance with AWCI 12-B, Standard Practice for the Testing and Inspection of Field Applied Thin Film Intumescent Fire-Resistive Materials.

END SECTION**FIRE PROTECTION – FIRE RESISTANT PENETRATIONS AND JOINTS SECTION****ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED:** ☐ ☒

FIRE RESISTANT PENETRATIONS AND JOINTS – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.17

TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Inspections of penetration firestop systems conducted in accordance with ASTM E 2174.	OBSERVE	{NOTE: This section applies to Risk Category III, IV, & V only. DOR may choose to uncheck this section where project is assigned to Risk Category I or II. Confirm Risk Category with Structural Engineer}
2. Inspections of fire-resistant joint systems conducted in accordance with ASTM E 2393	OBSERVE	

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

FIRE PROTECTION – SMOKE CONTROL SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

SMOKE CONTROL – VERIFY THE FOLLOWING ARE IN COMPLIANCE
2018 IBC 1705.18

TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Verify device locations and perform leakage testing	OBSERVE	Perform during erection of ductwork and prior to concealment
2. Pressure difference testing, flow measurements and detection and control verification	OBSERVE	Perform prior to occupancy and after sufficient completion

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

ARCHITECTURAL - EXTERIOR INSULATION AND FINISH SYSTEMS SECTION**ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☒**

EXTERIOR INSULATION AND FINISH SYSTEMS (EIFS) – VERIFY THE FOLLOWING ARE IN COMPLIANCE 2018 IBC 1705.16		
TASK	INSPECTION TYPE ¹	DESCRIPTION
1. Water resistive barrier coating applied over a sheathing substrate.	OBSERVE	Verify that water resistive barrier coating complies with ASTM E 2570. [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 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

END SECTION

¹ **OBSERVE:** Observe these items on a random sampling basis daily to insure that applicable requirements are met. Operations need not be delayed pending these inspections at contractor's risk.

PLUMBING/MECHANICAL/ELECTRICAL DESIGNATED SEISMIC SYSTEMS SECTION

ALL OR PORTIONS OF THIS SECTION ARE APPLICABLE IF BOX IS CHECKED: ☐ ☒

PLUMBING, MECHANICAL AND ELECTRICAL IBC 1705.12.6		
TASK	INSPECTION TYPE ¹	DESCRIPTION
{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.

This Page Intentionally Left Blank

Project: Joint Cryptologic Center Expansion - BSFB
 Location: Aurora, CO
 Project #: BU81
 Date: 12/7/2021



STATEMENT OF SPECIAL INSPECTIONS

Project Seismic Design Category: B
 Project Risk Category: II
 Project Design Wind Speed (mph): 115
 Number of Stories: 2
 Structure Height Above Grade (ft): 37
 Hazardous Occupancy or attached to such? No Group H Occupancies

Special Inspector of Record (SIOR)

A Special Inspector of Record (SIOR) IS NOT required (per UFGS 01 45 35, Section 1.3.8)

Lateral Force Resisting System (LFRS)

2018 IBC 1704.3.2 and 1704.3.3

Following is a listing of critical main wind/seismic force resisting systems for this structure. Carefully inspect these elements as part of the roles and responsibilities of the Special Inspector (reference the Schedule of Special Inspections for inspection checklists).

Vertical LFRS Elements	Notes
Ordinary Reinforced Masonry Shear Walls	Perimeter Shear Walls
Horizontal LFRS Elements	Notes
Concrete over metal deck	Second Floor
Metal Roof Deck & Related Fastening System	See Roof Plan

Project: Joint Cryptologic Center Expansion - BSFB

Location: Aurora, CO

Project #: BU81

Date: 12/7/2021

Designated Seismic Systems (DSS)

(2018 IBC 1705.13.3) (ASCE 7-16, 13.2.2, C13.2.2) (UFC 3-301-1, 2-5.3)

DESIGNATED SEISMIC SYSTEMS DO NOT APPLY TO THIS PROJECT, due to the Seismic Design Category being less than C.

ELECTRICAL Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

N/A

N/A

N/A

N/A

N/A

If additional space is required, append an additional sheet listing the remaining DSS

MECHANICAL/PLUMBING Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

N/A

N/A

N/A

N/A

N/A

N/A

If additional space is required, append an additional sheet listing the remaining DSS

OTHER Designated Seismic Systems (DSS) Requiring a Certificate of Compliance

N/A

N/A

N/A

N/A

N/A

N/A

Final Walk Down Inspection and Report

(UFC 3 301 01 SECTION 2-5.4)

Final Walk Down Inspection of non-structural Designated Seismic Systems does not apply to this project (no Designated Seismic Systems)

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 57 20.00 10

ENVIRONMENTAL PROTECTION

12/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Environmental Pollution and Damage
 - 1.2.2 Environmental Protection
 - 1.2.3 Contractor Generated Hazardous Waste
 - 1.2.4 Installation Pest Management Coordinator
 - 1.2.5 Land Application for Discharge Water
 - 1.2.6 Pesticide
 - 1.2.7 Pests
 - 1.2.8 Surface Discharge
 - 1.2.9 Waters of the United States
 - 1.2.10 Wetlands
- 1.3 GENERAL REQUIREMENTS
- 1.4 SUBCONTRACTORS
- 1.5 PAYMENT
- 1.6 SUBMITTALS
- 1.7 ENVIRONMENTAL COORDINATION, PERMITS, NOTICES, REVIEWS AND/OR APPROVALS
 - 1.7.1 Applications, Supporting Documents, and Fees
 - 1.7.2 Buckley SFB's Environmental Permits, Notices, Reviews, and/or Approvals
- 1.8 ENVIRONMENTAL PROTECTION PLAN
 - 1.8.1 Compliance
 - 1.8.2 Contents
 - 1.8.3 Appendix
- 1.9 PROTECTION FEATURES
- 1.10 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS
- 1.11 NOTIFICATION

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

- 3.1 ENVIRONMENTAL PERMITS AND COMMITMENTS
- 3.2 LAND RESOURCES
 - 3.2.1 Work Area Limits
 - 3.2.2 Landscape
 - 3.2.3 Erosion and Sediment Controls
 - 3.2.4 Contractor Facilities and Work Areas
- 3.3 WATER RESOURCES
 - 3.3.1 Dewatering Operations
- 3.4 AIR RESOURCES
 - 3.4.1 Particulates

- 3.4.2 Odors
- 3.4.3 Sound Intrusions
- 3.4.4 Burning
- 3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL
 - 3.5.1 Solid Wastes
 - 3.5.2 Chemicals and Chemical Wastes
 - 3.5.3 Contractor Generated Hazardous Wastes/Excess Hazardous Materials
 - 3.5.4 Fuel and Lubricants
 - 3.5.5 Waste Water
- 3.6 RECYCLING AND WASTE MINIMIZATION
- 3.7 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT
- 3.8 HISTORICAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES
- 3.9 BIOLOGICAL RESOURCES
 - 3.9.1 Burrowing Owl (*Athene cunicularia*)
 - 3.9.2 Bald Eagle (*Haliaeetus leucocephalus*)
- 3.10 INTEGRATED PEST MANAGEMENT
 - 3.10.1 Pesticide Delivery and Storage
 - 3.10.2 Qualifications
 - 3.10.3 Pesticide Handling Requirements
 - 3.10.4 Application
- 3.11 PREVIOUSLY USED EQUIPMENT
- 3.12 MAINTENANCE OF POLLUTION FACILITIES
- 3.13 MILITARY MUNITIONS
- 3.14 TRAINING OF CONTRACTOR PERSONNEL
- 3.15 POST CONSTRUCTION CLEANUP

-- End of Section Table of Contents --

SECTION 01 57 20.00 10

ENVIRONMENTAL PROTECTION
12/21

PART 1 GENERAL

1.1 REFERENCES

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

WETLAND MANUAL Corps of Engineers Wetlands Delineation Manual Technical Report Y-87-1

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

33 CFR 328 Definitions of Waters of the United States
40 CFR 152 - 186 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 279 Standards for the Management of Used Oil
40 CFR 302 Designation, Reportable Quantities, and Notification
40 CFR 355 Emergency Planning and Notification
40 CFR 68 Chemical Accident Prevention Provisions
49 CFR 171 - 178 Hazardous Materials Regulations

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 shall 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" shall occur. Land Application shall 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

Wetlands means 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 WETLAND MANUAL.

1.3 GENERAL REQUIREMENTS

The Contractor shall 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 shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations.

1.4 SUBCONTRACTORS

The Contractor shall ensure compliance with this section by subcontractors.

1.5 PAYMENT

No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the contract price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations.

1.6 SUBMITTALS

The following administrative submittals shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan; G-RO

1.7 ENVIRONMENTAL COORDINATION, PERMITS, NOTICES, REVIEWS AND/OR APPROVALS

The Contractor shall be responsible for contacting 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, the Contractor shall be responsible for coordinating the

requirements with the Environmental Flight and the Contracting Officer in regard to implementation for a Federal Facility project. In addition, the Environmental Flight of Buckley SFB shall be provided a copy of any permit applications prior to submission to the regulating agency, and shall also be provided a copy of the final permit, once obtained. The Contractor shall ensure that all coordination, permits, notices, reviews and/or approvals are completed with each applicable phase of the design prior to construction starting for that phase. The Contractor shall be responsible for any contract delays resulting from failure to obtain environmental permits, notices, reviews and/or approvals when required.

1.7.1 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.

1.7.2 Buckley SFB's 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 to be used in successfully accomplishing the environmental compliances.

- a. In the State of Colorado, **EPA** has authority for the National Pollutant Discharge Elimination System (NPDES) on **Federal Facilities**. Construction activities which result in the disturbance of 1 acre of land or more, require coverage under the EPA Storm Water General Permit For Construction Activities (Colorado Permit No. COR40000). The Contractor shall be the permittee. The Contractor shall be responsible for editing and applying Specification Section 01 41 26.05 24 (FEDERAL FACILITIES COLORADO) NPDES PERMIT REQUIREMENTS FOR STORM WATER DISCHARGES FROM CONSTRUCTION SITES.
- b. Municipal Separate Storm Sewer Systems (MS4) Permit. Buckley Space Force Base is under a Municipal Separate Storm Sewer System (MS4) permit, issued by the US Environmental Protection Agency (EPA), which allows discharges of stormwater from Buckley SFB. The MS4 permit also requires Buckley SFB to manage a stormwater program and enforce compliance with EPA-issued permits.
- c. A State of Colorado Air Pollution Emission Notice (APEN) for Fugitive Dust Permit for Land Development is required, if construction disturbs surface areas of more than 25 contiguous acres **or** if surface areas of more than 1 acre are to remain disturbed more than six months. The Colorado Department of Public Health and Environment (CDPHE), Division Air Quality issues the permit. The Contractor shall be the permittee and the permit is required prior to any construction starting on the project

site. The submittal package to CDPHE shall include a completed Air Pollution Emission Notice (APEN), a Land Disturbance Dust Control Plan, the grading plan, the location plan, and the application fee. The CDPHE requires a minimum of 30 days for review of the package. Prior to issuing the Construction Permit, CDPHE requires the permittee to pay the cost of the review in addition to the application fee.

- d. A State of Colorado (CDPHE) Air Pollution Control Division APEN permit for Application for Construction Permit. Buckley Space Force Base has a Title V air permit for the base. Any new generators with diesel reciprocating internal combustion engines will need to be approved by the State. The Contractor is required to pay any fees associated with this permit. Also, if this project has any new air emissions source, such as new generator, the Contractor will be required to furnish the Buckley Space Force Base Environmental Flight Office a copy of all required air emissions information to be added to their current air permit.
- e. The City of Aurora, Colorado has a review/permit requirement for any new water, sewer lines, and lift stations. The plans and specifications show the location and type of pipes used will need to be forwarded to the city of Aurora prior to installation/construction. The Contractor is to forward these along with any necessary fees for approval prior to installation. The Contractor shall be responsible for coordination with Buckley Space Force Base Environmental Flight Office before submittal to the City of Aurora.
- f. Coordination and notification may be required prior to discharge of hydrostatic test water and disinfection water to the sanitary sewer and/or to the surface for land application. The Contractor shall be responsible for coordination with the Environmental Flight, 460 CES/CEV, and the Contracting Officer prior to discharge. The discharge shall be in accordance with all Federal, State, and local laws and regulations.
- g. If this project will use materials containing hazardous materials. Safety Data Sheets for all chemicals must be available on site at all times. Only ESOH-MIS (formally EMIS) approved chemicals are allowed on Buckley SFB. No hazardous chemicals are allowed to be left on Buckley SFB without prior written approval from the contracting officer or his representative.
- h. All work performed on domestic water mains must comply with ANSI/AWWA C651-99 (most current revision). All water main flushing, superchlorination, bacteriological testing and other activities involving the water mains must be coordinated through Bioenvironmental Engineering. Contact the main number at (720) 847-6351.

1.8 ENVIRONMENTAL PROTECTION PLAN

Prior to commencing construction activities or delivery of materials to the site, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer. 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 shall be defined within the

Environmental Protection Plan as outlined in this section. The Contractor shall 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 which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall 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 shall be current and maintained onsite by the Contractor.

1.8.1 Compliance

No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.8.2 Contents

The environmental protection plan shall include, but shall not be limited 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 shall 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. The Spill Prevention and Control Plan (SPCC) 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 SPCC supplements the requirements of EM 385-1-1 and the Facility's Haz Mat Plan. The Hazardous Material Emergency Response Plan may be reviewed at the Environmental Flight office. 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 notify the Contracting Officer and Facility Fire Department in addition to the legally required Federal, State, and local reporting channels (including the National Response Center 1-800-424-8802) if a reportable quantity is released to the environment. 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 cleanup.

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.

j. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor shall attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. The report shall be submitted on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and shall be for the previous quarter (e.g. the first working day of January, April, July, and October). The report shall indicate the total amount

of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.

k. A recycling and solid waste minimization plan with a list of measures to reduce consumption of energy and natural resources. The plan shall detail 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 Safety Data Sheets (SDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated. Copies of all correspondence, inventories, notifications, etc. to the appropriate Base's Hazardous Material Office and the Contracting Officer shall be included in the plan.

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, 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, 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, include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge. Do not discharge to the sanitary sewer wastewater which differs significantly in quantity or quality from discharges under normal conditions without permission from Metro Water Recovery (Metro), Buckley's wastewater regulator. To obtain permission to discharge to the sanitary sewer, provide analytical sampling showing that the discharge meets Metro regulatory limits. Allow a minimum of four weeks and contact Matthew Cohen, matthew.cohen.4@spaceforce.mil Water Quality PM to coordinate permission or to report an accidental discharge to the sanitary sewer.

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. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Contracting Officer.

p. 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.

1.8.3 Appendix

Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached, as an appendix, to the Environmental Protection Plan.

1.9 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, Contracting Officer, and Base Natural Resources Manager shall make a joint condition survey. Immediately following the survey, the Contractor shall 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 shall be signed by both the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall 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 Contractor's work under the contract.

1.10 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer 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.

1.11 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. The Contractor shall, after receipt of such notice, inform the Contracting Officer of the proposed corrective action and take

such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor 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 ENVIRONMENTAL PERMITS AND COMMITMENTS

The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations.

3.2 LAND RESOURCES

Confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. Do not fasten or attach any ropes, cables, or guys 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. Limit equipment, staging, and storage to stabilized and/or paved surfaces to eliminate unnecessary disturbances of vegetated areas.

3.2.1 Work Area Limits

Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.2.2 Landscape

Clearly identify trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved 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. Development of specifications for relocation/replacing trees and landscaping, and submission of those specifications in conjunction with design submittals will be the responsibility of the D/B designer. Water all relocated trees and shrubs for no less than twelve months after relocation, unless an irrigation system is provided. Avoid all disturbances of vegetated areas as much as feasible. Revegetate any disturbed areas IAW the Buckley installation facility standards (IFS) and

specified seed mixes. Replace all disturbed or removed landscaping and sod with a like kind, and in accordance with the Buckley IFS.

3.2.3 Erosion and Sediment Controls

Provide erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. Erosion controls are required on all disturbed areas with a slope greater than 1% to prevent erosion/sediment transport prior to establishing vegetation. In addition, install erosion controls to prevent erosion with concentrated flows along ditch flow lines and outlet points. Select and maintain erosion and sediment controls such that construction activities do not result in sediment and other pollutants leaving the site, entering the stormwater sewer system, and violating the Base's MS4 permit. Clean vehicle tracking on to impervious streets and roadways by the end of each working day. The area of bare soil exposed at any one time by construction operations should be kept to a minimum. Construct or install temporary and permanent erosion and sediment control best management practices (BMPs). BMPs may include, but not be limited to, vegetation cover, silt fences, stream bank stabilization, slope stabilization, silt fences, construction of terraces, interceptor channels, sediment traps, inlet and outfall protection, diversion channels, and sedimentation basins. Erosion controls selected shall be sufficient to prevent formation of rills and gullies from erosion and the transport of sediment. Install BMPs before any site work commences, and remove only after the site has been seeded, and stabilized in accordance with the Installation Facility Standards (IFS).

3.2.4 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.3 WATER RESOURCES

The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that surface water when required by State or Federally issued Clean Water Act permits.

3.3.1 Dewatering Operations

Construction operations for dewatering shall be controlled at all times to maintain compliance with existing State water quality standards and designated uses of the surface water body. The Contractor shall comply with the State of Colorado water quality standards and anti-degradation provisions.

3.4 AIR RESOURCES

Equipment operation, activities, or processes performed by the Contractor shall be in accordance with all Federal, State, and Buckley air emission and performance laws and standards.

3.4.1 Particulates

Dust particles; aerosols and gaseous by-products from construction activities; and processing and preparation of materials, such as from asphalt batch plants; shall be controlled at all times, including weekends, holidays and hours when work is not in progress. The Contractor shall 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. Best Management Practices shall be used to minimize fugitive dust. Opacity may not exceed 20% and measures shall be taken to prevent fugitive dust from migrating off-base. 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. The Contractor must have sufficient, competent equipment available to accomplish these tasks. Particulate control shall be performed as the work proceeds and whenever a particulate nuisance or hazard occurs. The Contractor shall comply with all State and local visibility regulations.

3.4.2 Odors

Odors from construction activities shall be controlled at all times. The odors shall not cause a health hazard and shall be in compliance with State regulations and/or local ordinances.

3.4.3 Sound Intrusions

The Contractor shall keep construction activities under surveillance and control to minimize environment damage by noise. The Contractor shall comply with the provisions of the State of Colorado rules.

3.4.4 Burning

Burning shall be prohibited on the Government premises.

3.5 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.5.1 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. The Contractor shall comply with site procedures pertaining to the use of landfill areas. Coordination with the CEV prior to removing waste off Buckley SFB.

3.5.2 Chemicals and Chemical Wastes

Prior to beginning any process that will use Hazardous Materials (HAZMAT), the user will contact 460 CES/CEIE with the amount of material to be used, where excess is to be stored, and the duration of the activity. Additionally, a list of all HAZMAT projected in construction will be supplied to CEV along with manufacturer-specific SDS Sheets for incorporation into the AF HAZMAT tracking database, EESOH-MIS. Chemicals shall be dispensed ensuring no spillage to the ground or water. Periodic inspections of dispensing areas to identify leakage and initiate corrective action shall be performed and documented. This documentation will be periodically reviewed by the Government. All hazardous materials need to be approved prior to bringing them on Buckley SFB. For any hazardous materials required to be brought on to the base please contact Harry Nuce (720) 847-5578 for assistance with request for authorization of hazardous materials. Chemical waste shall be collected in corrosion resistant, compatible containers. 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 classified, managed, stored, and disposed of in accordance with Federal, State, and local laws and regulations. Hazmat usage reports shall be forwarded monthly to Matthew Christensen at matthew.w.christensen11@us.af.mil.

3.5.3 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 segregate hazardous waste from other materials and wastes, shall protect it from the weather by placing it in a safe covered location, and shall take precautionary measures such as berming or other appropriate measures against accidental spillage. The Contractor shall be responsible for storage, describing, packaging, labeling, marking, and placarding of hazardous waste and hazardous material in accordance with 49 CFR 171 - 178, State, and local laws and regulations. The Contractor shall transport Contractor generated hazardous waste off Government property within 60 days in accordance with the Environmental Protection Agency and the Department of Transportation laws and regulations. The Contractor shall dispose of hazardous waste in compliance with Federal, State and local laws and regulations. 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.

3.5.4 Fuel and Lubricants

Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill

and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. There shall be no storage of fuel on the project site. Fuel must be brought to the project site each day that work is performed.

3.5.5 Waste Water

Disposal of waste water shall be as specified below.

- a. Waste water from construction activities, such as on site 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 or by collecting and placing it in a retention pond where suspended material can be settled out and/or the water can evaporate to separate pollutants from the water. The site for the retention pond shall be coordinated and approved with the Contracting Officer. The residue left in the pond prior to completion of the project shall be removed, tested, and disposed off-Government property in accordance with Federal, State, and local laws and regulations. The area shall be backfilled to the original grade, top-soiled and seeded/sodded.
- b. Water generated from dewatering activities shall be land applied on site in accordance with both the Federal and the State of Colorado laws and regulations for land application.
- 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 shall be discharged into the sanitary sewer with prior approval and/or notification to the Waste Water Treatment Plant's Operator. Please contact the 460 CES/CEIE Water Quality Program Manager (WQPM) Matthew Cohen (720)847-4655 at least 14 business days before any discharge to the sanitary sewer or quality from discharges under normal conditions and/or that may disrupt Wastewater System treatment processes or operations.

3.6 RECYCLING AND WASTE MINIMIZATION

The Contractor shall 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.

3.7 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. The contractor shall divert from the landfill all eligible solid waste during construction and demolition activities. The Air Force goal for solid waste diversion is 60 percent. The goal for solid waste diversion for this project will also be 60 percent by weight. Diversion can be

accomplished through recycling, waste to energy incineration, composting, mulching, reuse, and donation. The Contractor shall submit a report to 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. Please forward this report to Matthew Christensen at matthew.w.christensen11@us.af.mil. The following shall be included in the report:

- a. Construction and Demolition (C&D) Debris Disposed = in cubic yards or tons, as appropriate.
- b. Construction and Demolition (C&D) Debris Recycled = in cubic yards or tons, as appropriate.
- c. Total C&D Debris Generated = in cubic yards or tons, as appropriate.
- d. Waste Sent to Waste-To-Energy Incineration Plant (This amount should not be included in the recycled amount) = in cubic yards or tons, as appropriate.
- e. Construction and Demolition debris (C&D) composted in cubic yards or tons, as appropriate.
- f. Construction and Demolition debris (C&D) mulched in cubic yards or tons, as appropriate.
- g. Construction and Demolition debris (C&D) reused in cubic yards or tons, as appropriate.
- h. Construction and Demolition debris (C&D) donated in cubic yards or tons, as appropriate.

3.8 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 shall 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 historical activities. Upon such discovery or find, the Contractor shall 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. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor shall secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.9 BIOLOGICAL RESOURCES

The Contractor shall minimize interference with, disturbance to, and damage to fish, wildlife, and plants including their habitat. The Contractor shall be responsible for the protection of threatened and endangered animal and plant species including their habitat in accordance with Federal, State, Regional, and local laws and regulations. The

Contractor shall be responsible for identifying and avoiding disturbing the following species and/or their habitat. The Contractor shall not assume that the list is all inclusive. These species have been identified on the Facility but are not at the present time on the project site. The Contractor shall be responsible for ensuring that his employees are able to identify and shall avoid disturbing the species and their habitat. The Contractor shall be responsible for coordinating with the Facility Environmental Flight and the Contracting Officer if Threatened and/or Endangered Species are found on the project site. The State of Colorado's Threatened and Endangered Species list along with descriptions of the species and their habitat may be found at <http://wildlife.state.co.us/T&E/list.asp>. A nesting bird survey will need to be completed prior to any clearing and grubbing or tree removal. The contact for the bird survey is Matt Rodgers, 460 CES/CEIE at 720-847-7245 or matthew.rodgers.7@us.ar.mil at least 7 days prior to any ground disturbance.

3.9.1 Burrowing Owl (*Athene cunicularia*)

The Burrowing Owl (*Athene cunicularia*) is a State of Colorado Threatened Species. Burrowing Owls uses prairie dog burrows as a nesting habitat. The burrowing owl may be found on the Facility, especially during the summer months. Unlike the prairie dogs the burrowing owls cannot be relocated and must not be disturbed during nesting (late March through July). Owls start to arrive in late February and remain until the end of October. If construction is starting during this period, a survey must be completed prior to start to ensure no owls are present. If found, construction would have to be delayed until the owl leaves. Construction should start and all potential nesting borrows should be removed before the bird arrives in the spring. Owl surveys can be completed by the Base Natural Resource Manager.

3.9.2 Bald Eagle (*Haliaeetus leucocephalus*)

The Bald Eagle has been seen but do not nest at this time on the Facility. The Bald Eagle prey on prairie dogs. The Government recommends avoiding roosting bald eagles by eliminating activity within 75 meters of the roosting bald eagle. However, this is a general recommendation, and may change dependant upon location, available cover, and concealment. It is the Contractor's responsibility to accurately determine appropriate distances to avoid disturbing the Bald Eagle. The Contractor shall ensure that his employees are able to identify bald eagles and shall avoid any disturbance of bald eagles.

3.10 INTEGRATED PEST MANAGEMENT

In order to minimize impacts to existing fauna and flora, the Contractor, through the Contracting Officer, shall coordinate with the Installation Pest Management Coordinator (IPMC) at the earliest possible time prior to pesticide application. The Contractor shall 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 Pest Management personnel shall 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 152 - 186.

3.10.1 Pesticide Delivery and Storage

Pesticides shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses. Pesticides shall be stored according to manufacturer's instructions and under lock and key when unattended.

3.10.2 Qualifications

For the application of pesticides, the Contractor shall use the services of a subcontractor whose principal business is pest control. The subcontractor shall be licensed and certified in the state where the work is to be performed.

3.10.3 Pesticide Handling Requirements

The Contractor shall formulate, treat with, and dispose of pesticides and associated containers in accordance with label directions and shall use the clothing and personal protective equipment specified on the labeling for use during all phases of the application. Material Safety Data Sheets (MSDS) shall be available for all pesticide products.

3.10.4 Application

All pesticide that is applied on Buckley SFB must be reported to the Entomology Shop during the month that it is actually used showing type, quantity, concentration, and location used. Pesticides shall be applied by a State Certified Pesticide Applicator in accordance with EPA label restrictions and recommendation. The Certified Applicator shall wear clothing and personal protective equipment as specified on the pesticide label. Water used for formulating shall only come from locations designated by the Contracting Officer. The Contractor shall not allow the equipment to overflow. Prior to application of pesticide, all equipment shall be inspected for leaks, clogging, wear, or damage and shall be repaired prior to being used.

3.11 PREVIOUSLY USED EQUIPMENT

The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

3.12 MAINTENANCE OF POLLUTION FACILITIES

The Contractor shall 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.

3.13 MILITARY MUNITIONS

In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260, the Contractor shall immediately stop work in that area and immediately inform the Contracting Officer.

3.14 TRAINING OF CONTRACTOR PERSONNEL

The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: 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.

3.15 POST CONSTRUCTION CLEANUP

The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, 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 shall be graded, filled and the entire area seeded unless otherwise indicated.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 57 23.00 10

STORM WATER POLLUTION PREVENTION MEASURES

2/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL
- 1.3 SUBMITTALS
- 1.4 EROSION AND SEDIMENT CONTROLS
 - 1.4.1 Stabilization Practices
 - 1.4.1.1 Permanent Seeding
 - 1.4.1.2 Temporary Seeding and Mulching
 - 1.4.1.3 Erosion Control Blankets
 - 1.4.2 Temporary Structural Practices
 - 1.4.2.1 Silt Fences
 - 1.4.2.2 Storm Drain Inlet Protection
 - 1.4.2.3 Culvert Inlet Protection
 - 1.4.2.4 Rock Check Dams
 - 1.4.2.5 Stone Construction Entrance
 - 1.4.2.6 Sediment Trap
 - 1.4.2.7 Diversion Dikes

PART 2 PRODUCTS

- 2.1 COMPONENTS FOR SILT FENCES
 - 2.1.1 Geotextile
 - 2.1.2 Silt Fence Stakes and Posts
 - 2.1.3 Mill Certificate or Affidavit
 - 2.1.4 Identification Storage and Handling
 - 2.1.5 Support Mesh
- 2.2 EROSION CONTROL BLANKETS
 - 2.2.1 Netless Erosion Control Blanket
 - 2.2.2 Single-Net Erosion Control Blanket
 - 2.2.3 Double-Net Erosion Control Blanket
- 2.3 COMPONENTS FOR SEDIMENT TRAP
- 2.4 COMPONENTS FOR INLET PROTECTION
- 2.5 STONE CONSTRUCTION ENTRANCE
- 2.6 ROCK CHECK DAMS
- 2.7 GEOTEXTILES

PART 3 EXECUTION

- 3.1 INSTALLATION OF SILT FENCES
- 3.2 SEDIMENT TRAP
- 3.3 STONE CONSTRUCTION ENTRANCE
- 3.4 MAINTENANCE
 - 3.4.1 Silt Fences
 - 3.4.2 Storm Drain Inlet Protection
 - 3.4.3 Rock Check Dams

- 3.4.4 Stone Construction Entrance
- 3.4.5 Sediment Traps
- 3.4.6 Diversion Dikes
- 3.5 INSPECTIONS
 - 3.5.1 General
 - 3.5.2 Inspections Details
 - 3.5.3 Inspection Reports

-- End of Section Table of Contents --

SECTION 01 57 23.00 10

STORM WATER POLLUTION PREVENTION MEASURES

2/20

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.

ASTM INTERNATIONAL (ASTM)

ASTM D448	(2012; R 2017) Standard Classification for Sizes of Aggregate for Road and Bridge Construction
-----------	--

ASTM D4873/D4873M	(2017) Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples
-------------------	---

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 288	(2021) Standard Specification for Geosynthetic Specification for Highway Applications
--------------	---

1.2 GENERAL

Install and maintain stabilization and structural best management practices (BMPs) which will minimize erosion and sediment pollution from the construction site to the extent attainable. The Contractor shall be responsible for selection of appropriate BMPs as specified herein. Additional BMPs may be deemed necessary by Buckley's Water Quality Program Manager or Stormwater Coordinator as the project progresses.

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-07 Certificates

Mill Certificate or Affidavit

1.4 EROSION AND SEDIMENT CONTROLS

The controls and measures required by the Contractor are described below.

1.4.1 Stabilization Practices

The stabilization practices to be implemented may include temporary seeding, mulching, sod stabilization, vegetative buffer strips, erosion control blankets, protection of trees, preservation of mature vegetation, etc. On his daily CQC Report, the Contractor shall record the dates when the major grading activities occur; when construction activities temporarily or permanently cease on a portion of the site; and when stabilization practices are initiated.

1.4.1.1 Permanent Seeding

Disturbed areas of the site where construction activities permanently ceases shall be stabilized with permanent seeding no more than 14 days after the construction activity ceases, except as follows. When the initiation of permanent seeding is stopped due to snow cover or arid conditions, permanent seeding shall be initiated as soon as practicable.

1.4.1.2 Temporary Seeding and Mulching

Areas where construction activities will temporarily cease for more than one year shall be temporarily seeded and mulched. Disturbed areas of the site where construction activities temporarily cease for more than 21 days and less than one year shall be stabilized with either temporary seeding and mulching or mulching not more than 14 days after construction activity ceases, except as follows. When the initiation of temporary stabilization measures is stopped due to snow cover or arid conditions, stabilization measures shall be initiated as soon as practicable. Seed mix that is to be used is the short grass prairie mix which can be obtained from the Base Natural Resources Manager. A nurse crop such as oats, or rye is recommended to be sown along with the grass mix to provide quick growth, weed control, and soil stabilization while the grass is getting started. A good soil seed bed will be established prior to seeding using at least 2" of quality top soil or 4" of compost mixed to a depth of 6 inches. Watering of seeded areas as required by temperature, moisture and wind conditions is required. Apply water at rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off, during germination process, seedlings are to be kept actively growing and not allowed to dry out.

1.4.1.3 Erosion Control Blankets

Erosion control blanket may be installed on steep slopes and in drainage swales and ditches to protect finished grades from erosion.

1.4.2 Temporary Structural Practices

Temporary structural practices shall be implemented to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site to the degree attainable. Temporary structural practices shall be implemented in a timely manner during the construction process to minimize erosion and sediment runoff. Temporary structural practices shall include but not be limited to the following devices.

1.4.2.1 Silt Fences

The Contractor shall provide silt fences as a temporary structural practice to minimize erosion and sediment runoff. Silt fences shall be

properly installed to effectively retain sediment immediately after completing each phase of work where erosion would occur in the form of sheet and rill erosion (e.g. clearing and grubbing, excavation, embankment, and grading). Silt fence barriers shall be installed along the down slope boundary of all disturbed areas prior to beginning land-disturbing activities in those areas. Silt fence barriers may be installed across ditches or swales but not where the drainage area is greater than 1 acre. Removal of silt fence barriers shall be approved by the Contracting Officer.

1.4.2.2 Storm Drain Inlet Protection

Storm drain inlet protection shall be installed at each new and existing inlet which receives storm runoff from disturbed areas of 1 acre or less. The protection at each inlet shall be removed once the disturbed area has been finally stabilized.

1.4.2.3 Culvert Inlet Protection

Culvert inlet protection shall be installed at all culverts with a drainage area of 1 acre or less.

1.4.2.4 Rock Check Dams

Rock check dams may be used to reduce erosion of temporary or permanent ditches or swales. Type 1 rock check dams shall be used when the upstream drainage area is less than 2 acres. Type 2 rock check dams shall be used when the upstream area is 2 to 10 acres.

1.4.2.5 Stone Construction Entrance

A stone construction entrance shall be constructed wherever traffic will be leaving the construction site and move directly onto a paved road. Stone construction entrances shall be removed after the site has been finally stabilized.

1.4.2.6 Sediment Trap

Sediment traps may be constructed below disturbed areas where the total contributing drainage area is less than 3 acres. Sediment traps, when used, should be constructed prior to disturbance of upslope areas. Sediment traps must have an initial storage volume of 134 cubic yards per acre of drainage area, half of which shall be in the form of a permanent pool or wet storage to provide a stable settling medium. The remaining half shall be in the form of a drawdown or dry storage which will provide extended settling time during less frequent, larger storm events.

1.4.2.7 Diversion Dikes

Diversion dikes may be constructed to divert runoff from upslope drainage areas away from unprotected disturbed areas and slopes to a stabilized outlet or to divert sediment-laden runoff from a disturbed area to a sediment-trapping facility such as a sediment trap or sediment basin. Diversion dikes shall have a maximum channel slope of 2 percent and shall be adequately compacted to prevent failure. The minimum height measured from the top of the dike to the bottom of the channel shall be 18 inches. The minimum base width shall be 6 feet and the minimum top width shall be 2 feet. The Contractor shall ensure that the diversion dikes are not damaged by construction operations or traffic.

PART 2 PRODUCTS

2.1 COMPONENTS FOR SILT FENCES

2.1.1 Geotextile

The geotextile shall comply with the requirements of AASHTO M 288 for temporary silt fence.

2.1.2 Silt Fence Stakes and Posts

The Contractor may use either wooden stakes or steel posts for fence construction. Wooden stakes utilized for silt fence construction, shall have a minimum cross section of 2 inches by 2 inches when oak is used and 4 inches by 4 inches when pine is used, and shall have a minimum length of 3 feet. Steel posts (standard "U" or "T" section) utilized for silt fence construction, shall have a minimum weight of 1.33 pounds per linear foot and a minimum length of 5 feet.

2.1.3 Mill Certificate or Affidavit

A mill certificate or affidavit shall be provided attesting that the geotextile and factory seams meet chemical, physical, and manufacturing requirements specified above. The mill certificate or affidavit shall specify the actual Minimum Average Roll Values and shall identify the fabric supplied by roll identification numbers. The Contractor shall submit a mill certificate or affidavit signed by a legally authorized official from the company manufacturing the geotextile.

2.1.4 Identification Storage and Handling

Geotextile shall be identified, stored and handled in accordance with ASTM D4873/D4873M.

2.1.5 Support Mesh

Support mesh shall be 14-1/2 gage or heavier steel wire with a mesh spacing of 6 by 6 inch or a prefabricated polymeric mesh of equivalent strength.

2.2 EROSION CONTROL BLANKETS

Installation staple patterns shall be clearly marked on the erosion control blanket with environmentally safe paint.

2.2.1 Netless Erosion Control Blanket

Erosion control blankets shall be a machine-produced mat with a biodegradable agricultural straw matrix (approximately 0.50 lb/sq yd). The blanket shall have a 12-month typical functional longevity and be designed for use on geotechnically stable slopes with gradients up to 1V:4H and channels with shear stresses up to 0.50 pounds per square foot.

2.2.2 Single-Net Erosion Control Blanket

Erosion control blankets shall be a machine-produced mat with a biodegradable agricultural straw matrix (approximately 0.50 lb/sq yd) and photodegradable netting on the top side. The blanket shall be sewn

together with degradable thread. The blanket shall have a 12-month typical functional longevity and be designed for use on geotechnically stable slopes with gradients up to 1V:3H and channels with shear stresses up to 1.50 pounds per square foot.

2.2.3 Double-Net Erosion Control Blanket

Erosion control blankets shall be a machine-produced mat with a biodegradable agricultural straw matrix (approximately 0.50 lb/sq yd) and photodegradable netting on each side. The blanket shall be sewn together with degradable thread. The blanket shall have a 12-month typical functional longevity and be designed for use on geotechnically stable slopes with gradients up to 1V:2H and channels with shear stresses up to 1.75 pounds per square foot.

2.3 COMPONENTS FOR SEDIMENT TRAP

Coarse aggregate shall conform to ASTM D448, Size 3, 357, or 5. Minor variations from the gradations specified will be permitted. Stone for riprap shall consist of field stone or rough unhewn quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering. The specific gravity of individual stones shall be at least 2.5. Riprap stones shall weigh between 50 and 150 pounds each, except that approximately 10 percent may weigh 50 pounds or less. At least 60 percent shall weigh more than 100 pounds. Geotextile shall conform to paragraph GEOTEXTILES.

2.4 COMPONENTS FOR INLET PROTECTION

Aggregates for gravel filter should be sized to get the greatest amount of filtering action possible (by using smaller-sized stone), while not creating significant ponding problems.

2.5 STONE CONSTRUCTION ENTRANCE

Aggregate for construction entrance shall conform to ASTM D448, Size 1. Minor variations from the gradation specified will be permitted. Geotextile shall conform to paragraph GEOTEXTILES.

2.6 ROCK CHECK DAMS

Coarse aggregate shall conform to ASTM D448 size number 1 or approved equal. Riprap shall consist of field stone or rough unhewn quarry stone of approximately rectangular shape. Riprap shall be hard and angular. The specific gravity of individual stones shall be at least 2.5. Concrete rubble may be used provided it has a density of at least 150 pcf. Individual stones shall have a weight of 50 to 150 lbs except that a maximum of 10 percent of stone may weigh less than 50 lbs. At least 60 percent of stones shall weigh more than 100 lbs.

2.7 GEOTEXTILES

Geotextile for other than silt fence shall comply with the requirements of AASHTO M 288 for a separation geotextile.

PART 3 EXECUTION

3.1 INSTALLATION OF SILT FENCES

Silt fences shall extend a minimum of 16 inches above the ground surface and shall not exceed 34 inches above the ground surface. Filter fabric shall be from a continuous roll cut to the length of the barrier to avoid the use of joints. When joints are unavoidable, filter fabric shall be spliced together at a support post, with a minimum 6 inch overlap, and securely sealed. A trench shall be excavated approximately 6 inches wide and 8 inches deep on the upslope side of the location of the silt fence. The 6-inch by 8-inch trench shall be backfilled and the soil compacted over the filter fabric. Silt fences shall be removed upon approval by the Contracting Officer.

3.2 SEDIMENT TRAP

The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat. Fill material for the embankment shall be placed in accordance with Best Management Practices (BMPs). A geotextile shall be placed between the riprap and subgrade.

3.3 STONE CONSTRUCTION ENTRANCE

The area of the entrance shall be cleared of all vegetation, roots, and other objectionable material. The aggregate layer shall have a minimum total thickness of 6 inches. A geotextile shall be placed beneath aggregate for the full width and length of the entrance. A minimum of 3 inches of the aggregate shall be placed in a cut section to provide stability and secure the geotextile. If conditions on the site are such that the majority of the mud is not removed by the vehicles traveling over the stone, then the tires of the vehicles shall be washed before entering the road. Wash water must be carried away from the entrance to an approved settling area to remove sediment. A wash rack may also be installed for washing of vehicles.

3.4 MAINTENANCE

The Contractor shall maintain the temporary and permanent vegetation, erosion and sediment control measures, and other protective measures in good and effective operating condition by performing routine inspections to determine condition and effectiveness, by restoration of destroyed vegetative cover, and by repair of erosion and sediment control measures and other protective measures. The following procedures shall be followed to maintain the protective measures.

3.4.1 Silt Fences

Silt fences shall be inspected in accordance with paragraph INSPECTIONS. Any required repairs shall be made promptly. Close attention shall be paid to the repair of damaged silt fence resulting from end runs and undercutting. Should the fabric on a silt fence decompose or become ineffective, and the barrier is still necessary, the fabric shall be replaced promptly. Sediment deposits shall be removed when deposits reach one-third of the height of the barrier. When a silt fence is no longer required, it shall be removed. The immediate area occupied by the fence and any sediment deposits shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded.

3.4.2 Storm Drain Inlet Protection

Inlet protection structures shall be inspected after each rainfall and repairs made as needed. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one half the design depth.

3.4.3 Rock Check Dams

Check dams should be checked for sediment after each runoff-producing storm event. Sediment should be removed when it reaches one half the original height of the measure.

3.4.4 Stone Construction Entrance

Stone construction entrances shall be maintained in a condition which will prevent tracking or flow of mud onto paved roads. This may require periodic top dressing with additional stone or the washing and reworking of existing stone as conditions demand and repair and/or cleanout of any structures used to trap sediment. The use of water trucks to remove materials dropped, washed, or tracked onto roadways will not be permitted under any circumstances.

3.4.5 Sediment Traps

Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one half the design volume of the wet storage. Filter stone shall be regularly checked to ensure that filtration performance is maintained. Stone choked with sediment shall be removed and cleaned or replaced. The structure should be inspected regularly to ensure that it is structurally sound and has not been damaged by erosion or construction equipment. The height of the stone outlet should be inspected to ensure that its center is at least 1 foot below the top of the embankment.

3.4.6 Diversion Dikes

Diversion dikes shall be inspected in accordance with paragraph INSPECTIONS. Close attention shall be paid to the repair of damaged diversion dikes and necessary repairs shall be accomplished promptly. When diversion dikes are no longer required, they shall be shaped to an acceptable grade. The areas disturbed by this shaping shall be seeded.

3.5 INSPECTIONS

3.5.1 General

The Contractor shall inspect disturbed areas of the construction site, areas used for storage of materials that are exposed to precipitation that have not been finally stabilized, stabilization practices, structural practices, other controls, and area where vehicles exit the site at least once every seven (7) calendar days and within 24 hours of the end of any storm that produces 0.5 inches or more rainfall at the site. Where sites have been finally stabilized, such inspection shall be conducted at least once every month.

3.5.2 Inspections Details

Disturbed areas and areas used for material storage that are exposed to

precipitation shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion and sediment control measures shall be observed to ensure that they are operating correctly. Discharge locations or points shall be inspected to ascertain whether erosion control measures are effective in preventing significant impacts to receiving waters. Locations where vehicles exit the site shall be inspected for evidence of offsite sediment tracking.

3.5.3 Inspection Reports

For each inspection conducted, the Contractor shall prepare a report summarizing the scope of the inspection, name(s) of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the storm water pollution prevention measures, maintenance performed, and actions taken. The report shall be furnished to the Contracting Officer within 24 hours of the inspection as a part of the Contractor's daily CQC REPORT. -- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

02/19, CHG 3: 11/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Co-mingle
 - 1.2.2 Construction Waste
 - 1.2.3 Demolition Debris/Waste
 - 1.2.4 Disposal
 - 1.2.5 Diversion
 - 1.2.6 Final Construction Waste Diversion Report
 - 1.2.7 Recycling
 - 1.2.8 Reuse
 - 1.2.9 Salvage
 - 1.2.10 Source Separation
- 1.3 CONSTRUCTION WASTE (INCLUDES DEMOLITION DEBRIS/WASTE)
- 1.4 CONSTRUCTION WASTE MANAGEMENT
 - 1.4.1 Implementation of Construction Waste Management Program
 - 1.4.2 Oversight
 - 1.4.3 Special Programs
 - 1.4.4 Special Instructions
 - 1.4.5 Waste Streams
- 1.5 SUBMITTALS
- 1.6 MEETINGS
- 1.7 CONSTRUCTION WASTE MANAGEMENT PLAN
- 1.8 RECORDS (DOCUMENTATION)
 - 1.8.1 General
 - 1.8.2 Accumulated
- 1.9 REPORTS
 - 1.9.1 General
 - 1.9.2 Quarterly Reporting
 - 1.9.3 Annual Reporting
- 1.10 FINAL CONSTRUCTION WASTE DIVERSION REPORT
- 1.11 COLLECTION
 - 1.11.1 Source Separation Method
 - 1.11.2 Other Methods
- 1.12 DISPOSAL
 - 1.12.1 Reuse
 - 1.12.2 Recycle
 - 1.12.3 HAZMART Disposal
 - 1.12.4 Compost
 - 1.12.5 Waste

PART 2 PRODUCTS

PART 3 EXECUTION

-- End of Section Table of Contents --

SECTION 01 74 19

CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL
02/19, CHG 3: 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.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 273	Standards for Universal Waste Management
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

1.2 DEFINITIONS

1.2.1 Co-mingle

The practice of placing unrelated materials together in a single container, usually for benefits of convenience and speed.

1.2.2 Construction Waste

Waste generated by construction activities, such as scrap materials, damaged or spoiled materials, temporary and expendable construction materials, and other waste generated by the workforce during construction activities.

1.2.3 Demolition Debris/Waste

Waste generated from demolition activities, including minor incidental demolition waste materials generated as a result of Intentional dismantling of all or portions of a building, to include clearing of building contents that have been destroyed or damaged.

1.2.4 Disposal

Depositing waste in a solid waste disposal facility, usually a managed landfill or incinerator, 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 or incinerator, 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 or incinerator. Follow applicable industry standards in the management of waste. Apply sound environmental principles in the management of waste. (1) Practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction waste and demolition debris/waste from landfills and incinerators and to facilitate the recycling or reuse of excess construction materials.

1.4 CONSTRUCTION WASTE MANAGEMENT

Implement a Construction Waste Management Program for the project. Take a pro-active, responsible role in the management of construction construction waste, recycling process, disposal of demolition debris/waste, and require all subcontractors, vendors, and suppliers to participate in the Construction Waste Management Program. Establish a process for clear tracking, and documentation of construction waste and demolition debris/waste.

1.4.1 Implementation of Construction Waste Management Program

Develop and document how the Construction Waste Management Program will be implemented in a Construction Waste Management Plan. Submit a Construction Waste Management Plan to the Contracting Officer for approval. Construction waste and demolition debris/waste materials include un-used construction materials not incorporated in the final work,

as well as demolition debris/waste materials from demolition activities or deconstruction activities. In the management of waste, consider the availability of viable markets, the condition of materials, the ability to provide material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates.

1.4.2 Oversight

The 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. Ensure firms and facilities used for recycling, reuse, and disposal are permitted for the intended use to the extent required by federal, state, and local regulations.

1.4.4 Special Instructions

Provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the projects. Designation of single source separating or commingling will be clearly marked on the containers.

1.4.5 Waste Streams

Delineate waste streams and characterization, including estimated material types and quantities of waste, in the Construction Waste Management Plan. Manage all waste streams associated with the project. Typical waste streams are listed below. Include additional waste streams not listed:

- a. Land Clearing Debris
- b. Asphalt
- c. Masonry and CMU
- d. Concrete
- e. Metals (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, bronze, etc.)
- f. Wood (nails and staples allowed)
- g. Glass
- h. Paper
- i. Plastics (PET, HDPE, PVC, LDPE, PP, PS, Other)
- j. Gypsum
- k. Non-hazardous paint and paint cans
- l. Carpet
- m. Ceiling Tiles
- n. Insulation
- o. Beverage Containers

1.5 SUBMITTALS

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

SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction Waste Management Plan; G, RO

SD-06 Test Reports

Quarterly Reports

Annual Report

SD-11 Closeout Submittals

Final Construction Waste Diversion Report; G, RO

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 installation Hazardous Waste Program Manager and 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 Quality Control meetings.
- c. Work safety meeting (if applicable).

1.7 CONSTRUCTION WASTE MANAGEMENT PLAN

Submit Construction Waste Management Plan within 30 calendar days after notice to proceed. Revise and resubmit Construction Waste Management Plan until it receives final approval from the installation Hazardous Waste Program Manager 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.
- l. Identification of at least 5 construction or demolition material streams for diversion.
- m. Detailed plan and distribution of waste diversion between buildings, when project is a part of a campus.
- n. Facilities or subcontractors offering construction waste transport on-site or off-site must ensure that proper shipping orders, bill of lading, manifests, or other shipping documents containing waste diversion information meet requirements of 40 CFR 273 Universal Waste Management, 49 CFR 173 Shippers - General Requirements for Shipments and Packagings, and 49 CFR 178 Specifications for Packaging. Individuals signing manifests or other shipping documents should meet the minimum training requirements.
- o. List each supplier who deliver construction materials, in bulk, or package products in returnable containers or returnable packaging, or have take-back programs. List each program and the applicable

material to actively monitor and track to assist in meeting waste diversion requirements on the project.

Distribute copies of the waste management plan to each subcontractor, Quality Control Manager, and the Contracting Officer.

1.8 RECORDS (DOCUMENTATION)

1.8.1 General

Maintain records to document the types and quantities of waste generated and diverted through re-use, recycling and/or sale to third parties; through disposal to a landfill or incinerator facility. Provide explanations for any materials not recycled, reused or sold. Collect and retain manifests, weight tickets, sales receipts, and invoices specifically identifying diverted project waste materials or disposed materials.

1.8.2 Accumulated

Maintain a running record of materials generated and diverted from landfill disposal, including accumulated diversion rates for the project. Make records available to the Contracting Officer during construction or incidental demolition activities. Provide a copy of the diversion records to the Contracting Officer upon completion of the construction, incidental demolitions or minor deconstruction activities.

1.9 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 quantities 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.

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.

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 other applicable contract requirements. 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 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, in compliance with paragraph 1.4 of this section, and in compliance with waste management procedures as described in the waste management plan. Except as otherwise specified in other sections of the specifications, recycle or 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. Consider the sale or donation of waste suitable for reuse.

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.

1.12.3 HAZMART Disposal

Dispose of all fluorescent lamps, HID lamps, mercury (Hg) containing thermostats and ampoules through the HAZMART as a Universal Waste. Do not crush lamps on site as this creates a hazardous waste stream with additional handling requirements. Dispose of PCBs containing ballasts and electrical components through the HAZMART. Properly collect and containerize in DOT-approved shipping containers, also approved by the HWMP, universal waste and PCBs. Properly label the containers in accordance with all federal regulations. Deliver all universal waste and PCBs requiring disposal to the HAZMART.

1.12.4 Compost

Consider composting on site if a reasonable amount of compostable materials will be available and a utilization of compostable material can be determined and appropriately planned for. Compostable materials include plant materials, sawdust and certain food scraps. Composting as a strategy must be explicitly addressed in the Construction Waste Management Plan submitted for approval to ensure it is feasible.

1.12.5 Waste

Dispose by landfill or incineration only those waste materials not listed above with no practical use, economic benefit, or recycling opportunity.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

07/06

PART 1 GENERAL

- 1.1 SUSTAINABILITY REQUIREMENTS
- 1.2 SUBMITTALS
- 1.3 SUBMISSION OF OPERATION AND MAINTENANCE DATA
 - 1.3.1 Package Quality
 - 1.3.2 Package Content
 - 1.3.3 Changes to Submittals
 - 1.3.4 Review and Approval
 - 1.3.5 O&M Database
- 1.4 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES
 - 1.4.1 Operating Instructions
 - 1.4.1.1 Safety Precautions
 - 1.4.1.2 Operator Prestart
 - 1.4.1.3 Startup, Shutdown, and Post-Shutdown Procedures
 - 1.4.1.4 Normal Operations
 - 1.4.1.5 Emergency Operations
 - 1.4.1.6 Operator Service Requirements
 - 1.4.1.7 Environmental Conditions
 - 1.4.2 Preventive Maintenance
 - 1.4.2.1 Lubrication Data
 - 1.4.2.2 Preventive Maintenance Plan and Schedule
 - 1.4.3 Corrective Maintenance (Repair)
 - 1.4.3.1 Troubleshooting Guides and Diagnostic Techniques
 - 1.4.3.2 Wiring Diagrams and Control Diagrams
 - 1.4.3.3 Maintenance and Repair Procedures
 - 1.4.3.4 Removal and Replacement Instructions
 - 1.4.3.5 Spare Parts and Supply Lists
 - 1.4.4 Corrective Maintenance Work-Hours
 - 1.4.5 Appendices
 - 1.4.5.1 Product Submittal Data
 - 1.4.5.2 Manufacturer's Instructions
 - 1.4.5.3 O&M Submittal Data
 - 1.4.5.4 Parts Identification
 - 1.4.5.5 Warranty Information
 - 1.4.5.6 Extended Warranty Information
 - 1.4.5.7 Personnel Training Requirements
 - 1.4.5.8 Testing Equipment and Special Tool Information
 - 1.4.5.9 Testing and Performance Data
 - 1.4.5.10 Contractor Information
- 1.5 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES
- 1.6 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES
 - 1.6.1 Data Package 1
 - 1.6.2 Data Package 2
 - 1.6.3 Data Package 3
 - 1.6.4 Data Package 4

1.6.5 Data Package 5

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 TRAINING

- 3.1.1 Training Plan
- 3.1.2 Training Content
- 3.1.3 Training Outline
- 3.1.4 Training Video Recording
- 3.1.5 Unresolved Questions from Attendees
- 3.1.6 Validation of Training Completion
- 3.1.7 Quality Control Coordination

-- End of Section Table of Contents --

SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
07/06

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 REQUIREMENTS AND REPORTING for project requirements.

1.2 SUBMITTALS

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

SD-10 Operation and Maintenance Data

O&M Database; G, RO

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 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors shall compile and prepare data and deliver to the Contractor prior to the training of Government personnel. Compile and prepare aggregate O&M data including 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. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.3.2 Package Content

Data package content shall be as shown in the paragraph titled "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. Commissioned items without a specified data package requirement in the individual technical sections shall use Data Package 3. Commissioned items with a Data Package 1 or 2 requirement shall use instead Data Package 3.

1.3.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data, shall be submitted by the Contractor within 30 calendar days of the notification of this change requirement.

1.3.4 Review and Approval

The Contractor's Commissioning Authority (CA) shall review the commissioned systems and equipment submittals for completeness and applicability. The CA shall verify 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 CA shall communicate deficiencies to the Contracting Officer. Upon a successful review of the corrections, the CA shall recommend approval and acceptance of these O&M manuals to the Contracting Officer. This work shall be in addition to the normal review procedures for O&M data.

1.3.5 O&M Database

Develop a database from the O&M manuals that contains the information required to start a preventative maintenance program.

1.4 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.4.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.4.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.4.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.4.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.4.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.4.1.5 Emergency Operations

Include 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. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.4.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.4.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.4.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

- a. A table showing recommended lubricants for specific temperature ranges and applications.
- b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.
- c. A Lubrication Schedule showing service interval frequency.

1.4.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. 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.

1.4.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.4.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.4.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.4.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.4.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.4.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.4.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.4.5 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:

1.4.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.4.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.4.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.4.5.4 Parts Identification

Provide identification and coverage for all 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 shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.4.5.5 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 such as the compressor of air conditioning system. Provide copies of warranties required by Section 01 78 36.00 24 WARRANTY OF CONSTRUCTION.

1.4.5.6 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 Section 01 78 36.00 24 WARRANTY OF CONSTRUCTION.

1.4.5.7 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.

1.4.5.8 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.

1.4.5.9 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.4.5.10 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.5 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 5 and the following for control systems:

- a. Narrative description on how to perform and apply all 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 all checkout tests and calibrations performed by the Contractor (not Cx tests).
- d. Full points list. A listing of rooms shall be provided 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 and/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. Electronic copy on disk or CD of the entire program for this facility.
- h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.6 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.6.1 Data Package 1

- a. Safety precautions
- b. Cleaning recommendations
- c. Maintenance and repair procedures
- d. Warranty information
- e. Contractor information
- f. Spare parts and supply list

1.6.2 Data Package 2

- a. Safety precautions
- b. Normal operations
- c. Environmental conditions
- d. Lubrication data
- e. Preventive maintenance plan and schedule
- 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. Contractor information

1.6.3 Data Package 3

- a. Safety precautions

- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Environmental conditions
- g. Lubrication data
- h. Preventive maintenance plan and schedule
- i. Cleaning recommendations
- j. Troubleshooting guides and diagnostic techniques
- k. Wiring diagrams and control diagrams
- l. Maintenance and repair procedures
- m. Removal and replacement instructions
- n. Spare parts and supply list
- o. Product submittal data
- p. O&M submittal data
- q. Parts identification
- r. Warranty information
- s. Testing equipment and special tool information
- t. Testing and performance data
- u. Contractor information

1.6.4 Data Package 4

- a. Safety precautions
- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Operator service requirements
- g. Environmental conditions
- h. Lubrication data
- i. Preventive maintenance plan and schedule

- 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. Corrective maintenance man-hours
- q. Product submittal data
- r. O&M submittal data
- s. Parts identification
- t. Warranty information
- u. Personnel training requirements
- v. Testing equipment and special tool information
- w. Testing and performance data
- x. Contractor information

1.6.5 Data Package 5

- a. Safety precautions
- b. Operator prestart
- c. Start-up, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Environmental conditions
- f. Preventive maintenance plan and schedule
- 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. Testing and performance data
- s. Contractor information

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 Operation and Maintenance Manual Files (Bookmarked PDF) and a written course outline listing the major and minor topics to be discussed by the instructor on each day of the course to each trainee in the course. Provide the course outline 14 calendar days prior to the training.

3.1.4 Training Video Recording

Record classroom training session(s) on video. Provide to the Contracting Officer two copies of the training session(s) in DVD video recording format. Capture within the recording, in video and audio, the instructors' training presentations including question and answer periods with the attendees. The recording camera(s) must be attended by a person during the recording sessions to assure proper size of exhibits and projections during the recording are visible and readable when viewed as training.

3.1.5 Unresolved Questions from Attendees

If, at the end of the training course, there are questions from attendees

that remain unresolved, the instructor must send the answers, in writing, to the Contracting Officer for transmittal to the attendees, and the training video must be modified to include the appropriate clarifications.

3.1.6 Validation of Training Completion

Ensure that each attendee at each training session signs a class roster daily to confirm Government participation in the training. At the completion of training, submit a signed validation letter that includes a sample record of training for reporting what systems were included in the training, who provided the training, when and where the training was performed, and copies of the signed class rosters. Provide two copies of the validation to the Contracting Officer, and one copy to the Operation and Maintenance Manual Preparer for inclusion into the Manual's documentation.

3.1.7 Quality Control Coordination

Coordinate this training with the CxA in accordance with Section 01 45 00.00 10 QUALITY CONTROL.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 24.00 10

FACILITY DATA REQUIREMENTS

05/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS AND ABBREVIATIONS
 - 1.2.1 Assets
 - 1.2.2 Attributes
 - 1.2.3 Facility Data
 - 1.2.4 Facility Document Set (FDS)
 - 1.2.5 Facility Data Workbook (FDW)
 - 1.2.6 Facility Data Project Execution Plan (FDPxP)
- 1.3 UNITS OF MEASURE
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Facility Data Project Execution Plan (FDPxP)
 - 1.5.1.1 Front Matter
 - 1.5.1.2 Project Information
 - 1.5.1.3 Submittal Schedule
 - 1.5.1.4 Personnel
 - 1.5.1.5 Facility Data Workbook(s)
 - 1.5.1.6 Facility Document Set(s)
 - 1.5.1.7 Protocols
 - 1.5.2 Meetings
 - 1.5.2.1 Pre-Construction Meeting
 - 1.5.2.2 FDPxP Coordination Meeting
 - 1.5.2.3 Submittal Coordination Meeting
 - 1.5.3 Facility Turnover and Contract Closeout
 - 1.5.4 Facility Data Workbook Quality Requirements
 - 1.5.5 Facility Document Set Quality Requirements
 - 1.5.5.1 Document Files
 - 1.5.5.2 Photograph Files
 - 1.5.5.3 Drawing Files
 - 1.5.6 Facility Document Set Integrity Requirements
 - 1.5.6.1 File Protection
 - 1.5.6.2 Manufacturer-Specific Documents
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.6.1 Number of Copies
 - 1.6.2 Malicious Content
 - 1.6.3 Storage Media

PART 2 PRODUCTS

- 2.1 FACILITY DATA WORKBOOK(S)
 - 2.1.1 Spaces
 - 2.1.2 Assets
 - 2.1.3 Attributes
- 2.2 FACILITY DOCUMENT SET

2.2.1 Organization

PART 3 EXECUTION

- 3.1 CONSTRUCTION PROGRESS SUBMITTALS
- 3.2 CONSTRUCTION FINAL SUBMITTALS
- 3.3 FACILITY DATA WORKBOOK VERIFICATION

-- End of Section Table of Contents --

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 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.

- b. 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.

1.3 UNITS OF MEASURE

Provide Facility Data deliverables utilizing the units of measure identified in the contract documents.

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

Facility Data Project Execution Plan(FDPxP)

SD-10 Operation and Maintenance Data

Facility Data Workbook, Construction Progress; G

Facility Document Set, Construction Progress; G

SD-11 Closeout Submittals

Facility Data Workbook, Construction Final; G

Facility Document Set, Construction Final; G

1.5 QUALITY ASSURANCE

1.5.1 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:

1.5.1.1 Front Matter

Provide a Cover Page, Table of Contents, and Executive Summary/Objectives.

1.5.1.2 Project Information

List the Project Owner, Project Name, Project Location and address, Contract Type, Project Description, Project/Contract Number, Project

Milestones.

1.5.1.3 Submittal Schedule

Identify delivery schedule for all deliverables in compliance with the submission requirements identified in this specification.

1.5.1.4 Personnel

Identify key personnel involved in the development of the Facility Data deliverables including Contractor and Government personnel.

1.5.1.5 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.

1.5.1.6 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.

1.5.1.7 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.

1.5.2 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:

1.5.2.1 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, and.
- c. Identify and agree upon a date and attendance list for the meetings described below:

1.5.2.2 FDPxP Coordination Meeting

- a. Facilitate a meeting following submission and Government review of the FDPxP. Include the Facility Data Preparer(s), Designer of Record (DOR), Quality Control (QC) Manager, Commissioning Authority (CxA), Government's Facility Data Proponent, Contracting Officer's Representative, and Facilities Management Specialist (FMS). Also include any Government personnel required for obtaining security clearances and waivers for proper Facility Data collection in this meeting.
- 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.

1.5.2.3 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 (CxA), Government's Facility Data Proponent, Contracting Officer's Representative, and 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.

1.5.3 Facility Turnover and Contract Closeout

Include the Facility Document Set, Construction Final as a deliverable in Facility Turnover and Contract Closeout procedures.

1.5.4 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.

1.5.5 Facility Document Set Quality Requirements

Ensure that information provided as part of each FDS conforms to the electronic and data formatting standards identified below:

1.5.5.1 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.

1.5.5.2 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.

1.5.5.3 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.

1.5.6 Facility Document Set Integrity Requirements

Ensure that information provided as part of each FDS conforms to the integrity standards identified below:

1.5.6.1 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.

1.5.6.2 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.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver facility data submittals in an organized and legible manner. Provide submittals adhering to the requirements of 01 33 00 SUBMITTAL REQUIREMENTS and 01 78 23 OPERATION AND MAINTENANCE DATA.

1.6.1 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.

1.6.2 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.

1.6.3 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 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.erdcdren.mil>.

2.1.1 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.

2.1.2 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 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.
- 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.

2.1.3 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.

2.2 FACILITY DOCUMENT SET

2.2.1 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:

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 60 days 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 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 COMMISSIONING. One-hundred percent accuracy of FDW information is required for Government acceptance of the and Facility Data Workbook, Construction Final submittal.

--Attachments--

Project Facility Data Worksheets

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 36.00 24

WARRANTY OF CONSTRUCTION

4/07

PART 1 GENERAL

- 1.1 WARRANTY OF CONSTRUCTION
- 1.2 ADDITIONAL WARRANTY REQUIREMENTS
 - 1.2.1 Performance Bond
 - 1.2.2 Pre-Warranty Conference
 - 1.2.3 Equipment Warranty Identification
 - 1.2.4 Warranty Service Calls
 - 1.2.5 Equipment Warranty Booklet
- 1.3 SUBMITTALS
- 1.4 EQUIPMENT WARRANTY IDENTIFICATIONS TAGS
 - 1.4.1 GENERAL REQUIREMENTS
 - 1.4.1.1 Tags and Information
 - 1.4.1.2 Tags for Warranted Equipment
 - 1.4.1.3 Exclusion to Providing Tags
 - 1.4.2 EXECUTION
 - 1.4.3 Equipment Warranty Tag Replacement

PART 2 NOT USED

PART 3 NOT USED

-- End of Section Table of Contents --

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.

(l) The Prime Contractor shall designate a representative to attend and chair warranty meetings that will be held each month at the project site for the duration of the warranty period, with government and subcontractor personnel as necessary. The meeting shall review past warranty corrections and response times, open warranty items, up-coming scheduled corrections, site investigations, and other issues.

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

The Contractor shall 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:

```

+-----+
|               EQUIPMENT WARRANTY               |
|               CONTRACTOR FURNISHED EQUIPMENT    |
|               MFG-----MODEL NO.-----      |
+-----+
```

SERIAL NO.-----
CONTRACT NO.-----
CONTRACTOR NAME-----
CONTRACTOR ADDRESS-----
CONTRACTOR TELEPHONE-----
CONTRACTOR WARRANTY EXPIRES-----
IN CASE OF WARRANTY ACTION FIRST CONTACT
[DEH] [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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 78 39.00 24

AS-BUILT DRAWINGS

PART 1 GENERAL

- 1.1 DEFINITIONS
 - 1.1.1 Red-Line Drawings
 - 1.1.2 As-Built Drawings
 - 1.1.3 Black-Line Drawings
 - 1.1.4 Full-Size Drawings
 - 1.1.5 Modification Circle
 - 1.1.6 Electronic CAD Files
 - 1.1.7 Building Information Modeling (BIM) Files
- 1.2 REFERENCES
- 1.3 SUBMITTALS
- 1.4 GENERAL REQUIREMENTS
 - 1.4.1 As-built Drawings
 - 1.4.2 Red-Line Drawings
 - 1.4.2.1 Red-Line Electronic Format
 - 1.4.3 Sustainability Documentation
- 1.5 CONTRACTOR PERFORMANCE RATING
- 1.6 TRANSMITTAL OF AS-BUILT DRAWINGS
 - 1.6.1 Optional As-built Drawings Sample
 - 1.6.2 50 Percent Preliminary As-Built Drawings
 - 1.6.3 100 Percent Preliminary As-Built Drawings
 - 1.6.4 Final As-Built Drawings
- 1.7 AS-BUILT DRAWINGS FORMAT REQUIREMENTS
 - 1.7.1 General Formatting
 - 1.7.2 Title Block
 - 1.7.3 Modification Changes
 - 1.7.4 Legends

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

- 3.1 GENERAL
- 3.2 SITE WORK
 - 3.2.1 Utilities
 - 3.2.2 Structures
 - 3.2.3 Grades
- 3.3 STRUCTURAL
 - 3.3.1 Steel/Concrete
- 3.4 MECHANICAL
 - 3.4.1 Ductwork
 - 3.4.2 Plumbing
- 3.5 ELECTRICAL
 - 3.5.1 PANELS
 - 3.5.2 Controls
- 3.6 CONTRACTOR SHOP DRAWINGS

ATTACHMENTS:

Modifications and Title Block Examples

-- End of Section Table of Contents --

SECTION 01 78 39.00 24

AS-BUILT DRAWINGS
07/20

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 bond 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.

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

Electronic CAD files in Autodesk (.dwg) and Revit (.rvt) in accordance with appropriate CAD standard. The CAD standard will include level on/off status, special characters, line weights, font, and size requirements.

1.1.7 Building Information Modeling (BIM) Files

Electronic files that model the project design as a 3D graphics that produce accurate construction documents as detailed in the available BIM Model.

1.2 REFERENCES

U.S. ARMY CORPS OF ENGINEERS (USACE)

ERDC/ITL TR-19-7 (2019) A/E/C CAD Standard - Release 6.1

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-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, AE

1.4 GENERAL REQUIREMENTS

1.4.1 As-built Drawings

Upon award of this contract, the Government will provide the Contractor PDFs of the Contract drawings. The Government will provide the Contractor the Electronic CAD Files (Revit (.rvt) file) for Building Drawings and Site Drawings.

Create electronic CAD files in Autodesk (.dwg), BIM Revit (.rvt) files for Building drawings, 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". Use the M3 Template located at <https://cadbimcenter.erdcdren.mil/>. See Section 01 33 39.00 10 ADVANCED MODELING (BIM/CIM/GIS/CAD) REQUIREMENTS for additional requirements.. This project utilizes the ERDC/ITL TR-19-7 USACE A/E/C CAD Standard which are to be used on 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.erdcdren.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. **The Do not convert electronic drawing files from one software language to another.** The transmittal requirements for the As-built Drawings shall be shown as activities on the Contractor prepared project schedule.

All changes from the contract drawings shall be shown on the as-builts. All changes shall be accurately and neatly recorded on the As-built drawings using the same symbols, terminology, and general quality as the

original set of contract drawings. All changes shall be shown 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. Systems designed or enhanced by the Contractor such as HVAC control system, fire alarm system fire sprinkler system, and irrigation sprinkler system, shall shown on the As-built drawings. Where contract drawings or specifications allow for options, only the option selected and actually constructed shall be shown on the As-Built Drawings.

1.4.2 Red-Line Drawings

Red-Line Drawings shall be updated throughout the construction phase of a contract showing all changes that will be shown on the final as-builts. All as-built conditions shall be on the Red-Line Drawings **within two (2) days** after the work activity is completed or shall be entered on the deficiency tracking system (see Section 01 45 00.00 10, QUALITY CONTROL). If the red-line drawings are not being updated, incomplete, or inaccurate, the Contractor shall be considered to not be making satisfactory progress and funds will be withheld from the progress payments.

The Contractor shall provide red-line drawings in an electronic format.

1.4.2.1 Red-Line Electronic Format

The Contractor shall 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. The Contractor shall 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. Each weekly file system backup shall be preserved over the course of the project and not overwritten; with file folders or individual media labeled with the date of backup. The weekly backup media shall be stored in a fireproof and waterproof safe in a locked room of the Contractor's trailer. The Contractor must also provide the COR with a DVD containing updated PDF drawings on a monthly basis. All changes to the electronic drawings shall be shown with clouding and in accordance with ERDC/ITL TR-19-7.

1.4.3 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 REPORTING for detailed requirements. All Sustainability documentation shall be submitted within 120 days after the final inspection. The Sustainability documentation shall be placed on two DVDs with one copy sent to the COR and one copy sent to the Omaha District Office (ATTN: Patricia Lambert, CENWO-CDS-C).

1.5 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.

1.6 TRANSMITTAL OF AS-BUILT DRAWINGS

1.6.1 Optional As-built Drawings Sample

The Contractor has the option to submit a sample of preliminary as-built drawings to the Omaha District Office that will be reviewed for formatting purposes. This submittal shall include five (5) distinct sheets from the project set of drawings. This optional submittal shall be sent to the Omaha District Office (ATTN: Patricia Lambert, CENWO-CDS-C) and contain the following:

1. One (1) DVD containing the following for each sheet:
 - a. Electronic CAD Files
 - b. Individual PDF Drawings
 - c. One (1) Combined Set of PDF Drawings with bookmarks for each sheet

1.6.2 50 Percent Preliminary As-Built Drawings

The 50 Percent Preliminary As-Built Drawings are to be submitted within ten (10) days after 50% physical completion unless otherwise directed by the COR. These drawings will be reviewed by the government for technical content and formatting requirements. The Electronic CAD Files shall include all changes up to the time 50 Percent Preliminary As-Built Drawings are furnished with "clouding" around the changes. All drawings contained in the complete project set of drawings plus any additional drawings shall be submitted with the 50 Percent Preliminary As-Built Drawings. The 50 Percent Preliminary As-Built Drawings shall be submitted within ten days after unless otherwise directed by the COR. 50 Percent Preliminary As-Built Drawings shall include the following:

1. One (1) DVD to the Omaha District Office (ATTN: Patricia Lambert, CENWO-CDS-C) containing the following:
 - a. Electronic CAD Files.
 - b. Individual PDF Drawings.
 - c. Combined Set of PDF Drawings with bookmarks for each sheet.
2. One set of electronic black-line drawings to the COR.

If a resubmittal is required, the contractor shall resubmit within fifteen days after receiving comments back from the government. If the contractor fails to submit the 50 Percent Preliminary As-Built Drawings by the specified time, the contractor shall be considered to not be making

satisfactory progress on the project and funds will be withheld from the progress payments.

1.6.3 100 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, the Contractor shall submit 100 Percent Preliminary As-Built Drawings indicating all as-built changes with "clouding" on all of the project drawings. All drawings contained in the complete project set of drawings plus any additional drawings shall be submitted 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. The Contractor shall not submit the Final As-Built Drawings until the 100 Percent Preliminary As-Built Drawings are approved. 100 Percent Preliminary As-Built Drawings shall include the following:

1. One (1) DVD to the Omaha District Office (ATTN: Patricia Lambert, CENWO-CDS-C) containing the following:
 - a. Electronic CAD Files.
 - b. Individual PDF Drawings.
 - c. Combined Set of PDF Drawings with bookmarks for each sheet.
2. One (1) set of electronic black-line drawings to the COR.
3. One (1) set of electronic red-line drawings to the COR.

1.6.4 Final As-Built Drawings

The Contractor shall produce Final As-Built Drawings without "clouding". The Final As-Built Drawings shall include all changes shown on the 100 Percent Preliminary As-Built Drawings including any additional required changes. All drawings contained in the complete project set of drawings plus any additional drawings shall be submitted with the Final As-Built Drawings. The Final Drawings shall be submitted no later than ten days after the 100 Percent Preliminary As-Built Drawing submittal is approved. The COR may grant the Contractor additional time if the Contractor is making reasonable progress on the as-builts. The Contractor shall send the following documents to the COR:

1. Three DVDs containing the following:
 - a. Electronic CAD Files.
 - b. Individual PDF Drawings.
 - c. Combined Set of PDF Drawings with bookmarks for each sheet.
2. One (1) set of electronic black-line drawings to the COR.
3. One (1) set of electronic red-line drawings to the COR
4. One set of full-size bond paper black-line As-built drawings.

The Contractor shall also send the following to the Omaha District Office (ATTN: Patricia Lambert, CENWO-CDS-C):

1. One DVD containing the following:
 - a. Electronic CAD Files.
 - b. Individual PDF Drawings.
 - c. Combined Set of PDF Drawings with bookmarks for each sheet.
2. One set of electronic black-line drawings.

1.7 AS-BUILT DRAWINGS FORMAT REQUIREMENTS

1.7.1 General Formatting

Preparation of As-built Drawings shall be in accordance with ERDC/ITL TR-19-7 requirements and/or match the detail shown on the contract drawings. The drawings shall include all of the requirements below:

- a. The drawing index shall be updated when drawings are added.
- b. When opened, the view shall be zoomed to fit the border.
- c. All files shall reference a border supplied by the CAD/BIM Technology Center (<https://cadbimcenter.erdcdren.mil/>) placed in the layout/sheet model at a scale of 1 at the location (0,0).
- d. All unnecessary information outside the border shall be deleted.
- e. All files shall be purged/compressed.
- f. All reference files shall be included and shall be 'Bound' (AutoCAD) or 'Attached' (Microstation) to the CADD files in which the files are referenced.
- g. All text shall use the Arial.ttf font.
- h. An ASCII text file shall be provided 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. Pen tables for plotting shall be supplied.
- j. Each sheet/design shall have its own file and file name with only one layout/sheet per design file.
- k. Half toning shall be accomplished by using the color 8 and setting the pen table to plot color 8 to half tone.
- l. The file name shall be the project code followed by the sheet identification number. The file name shall be included in the border on every sheet and shall match the name of the file on the DVD. The project code is BU81.
- m. The File number shall be included in the border on every sheet. The file number is: (the Contract number, to be provided at award).
- n. The cover sheet will have "Contract Award Set" changed to "As-Built Record Set" with month & year completed.
- o. All preliminary as-builts and redlines shall show drawing changes by "clouding" the affected area in layer G-ANNO-REVS in the drawing file.
- p. All submitted Electronic CAD Files and PDF drawings shall be under a folder labeled "As-Built" on the submitted DVD.
- q. Both the DVD case and DVD shall contain the name of the project, location, project code, solicitation number, contract number, and words detailing which submittal it is. The Final As-builts Drawings should be titled "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. The Electronic CAD files and PDF drawings shall be in separate folders on each DVD.

1.7.2 Title Block

All information in the title block shall be filled in and correct. The title block shall also include all of the requirements below.

- a. "RECORD DRAWING" text shall be added below the title block on the right side of the drawing on all sheets.

- b. The date to be added in the revision box for modifications is found in Block 3 of Form SF-30.
- c. The top line of the revision box shall state "REVISED TO SHOW AS-BUILT CONDITIONS" and dated. Use a "-" for the "Mark".
- d. The date box shall have the month and year as-builts were completed.
- f. The approved box shall have the initials PEL.
- e. The contract number and the solicitation number (if available) shall be shown on all sheets.
- f. Additional word abbreviations, not found on the abbreviation sheet but necessary to describe the work, shall be properly identified and incorporated with the other standard word abbreviations.
- g. Modifications should be properly noted in the title block in accordance with paragraph "Modification Changes" below.

1.7.3 Modification Changes

All modification changes shall be included on the as-built drawings. Modification changes at a minimum shall include all revised and reissued sheets, descriptive changes, sketches, etc. Any modification change that also affects other sheets other than the one referenced with the modification shall also be changed as appropriate. 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. Modifications shall be posted in accordance with the following.

- a. Follow directions in the modification for posting all changes.
- b. All modifications to the contract shall be posted in chronological order.
- c. The last modification number completed on the sheet should be shown with the modification circle in the top right corner of the "Project Title" and "Project Location" box.
- d. All modifications to all plans, sections, or details, shall have a modification number placed in the revision box over column entitled "Mark". The statement "GENERAL REVISIONS" may be used when applicable.
- e. The Modification Circle size shall be 1/2-inch diameter unless the area where circle is to be placed is crowded. Use smaller size circle for crowded areas.
- f. A Modification Circle shall be place 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, a Modification Circle shall be placed either by the schedule heading or by the change in the schedule.

1.7.4 Legends

Symbols, which conflict with those on the original contract legend sheet, shall not be used. Additional symbols, necessary to depict any additional work items, shall be properly identified and added to the legend sheet or supplemental legend. 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

The Contractor shall 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. The Contractor shall provide any additional drawings as required to display all details. In addition, the GeoDatabase Files shall be prepared as specified above and submitted in conjunction with the As-Built drawings.

3.2 SITE WORK

3.2.1 Utilities

The as-built drawings shall show all utilities whether active or abandoned, and will include all those shown on the original contract drawings or found on-site. The type of utility, location, general direction, size, material make-up and depth shall be shown. The location and description of any utility line or other installations of any kind known to exist within the construction area shall be shown. The location shall include dimensions to permanent features. All new underground utility lines (including electrical power and communications, gas, water, sanitary sewer, storm drains, roof drains and culverts) shall be located during installation. The Contractor shall 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). Storm drains and sanitary sewer lines shall be surveyed where pipes enter manholes and inlets and at 100-foot maximum intervals along the line. The inverts of all cleanouts and tees shall be surveyed. Inverts at each end of culverts shall be surveyed. Electrical power, communications, gas and water lines shall be surveyed at all manholes, tees, valves, corners, changes in direction and at intervals along the line which will accurately depict the location of the line in both horizontal and vertical directions (50-foot maximum interval). The horizontal and vertical accuracy shall be that 100% of the points are + 0.25' of their absolute position. New underground utility lines shall be shown as 3-dimensional elements in a Autodesk.dwg file.

3.2.2 Structures

Structures above and below ground shall be shown. The size, material make-up, location, height, and/or depth shall be shown. Manholes shall show rim elevation and invert elevations as applicable. Power poles shall show electrical equipment, guy wires, and voltage rating.

3.2.3 Grades

Grade or alignment of roads, structures, or utilities shall be corrected if any changes were made from the contract drawings. Elevations shall be corrected if changes were made in site grading. If any grades are finalized outside of the respective grades tolerances, that new grade shall be shown on the as-builts.

3.3 STRUCTURAL

3.3.1 Steel/Concrete

Shop drawings that deviate from the contract drawings shall be incorporated in the As-Built Drawings.

3.4 MECHANICAL

3.4.1 Ductwork

Ductwork shall be shown to reflect actual installation and duct size. Ductwork routing changes shall be shown.

3.4.2 Plumbing

Piping and fixtures shall be shown to reflect the type of material, size and the route or location.

3.5 ELECTRICAL

3.5.1 PANELS

All contract drawing panel schedules shall be revised to show as-built conditions. Home-run circuit designation on electrical drawings shall accurately correspond to the as-built panel schedules.

3.5.2 Controls

All control diagrams in contract drawings shall be revised to reflect as-built conditions, and setpoints.

3.6 CONTRACTOR SHOP DRAWINGS

Contractor shop drawings, which supersede data on the contract plans and/or additional drawings, prepared by the Contractor, shall be incorporated into the As-Built Drawings. Design plans prepared by the Contractor shall include the designer's name on the As-Built Drawings.


-- End of Section --

This page was intentionally left blank for duplex printing.

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. ADD ARCHITECT-ENGINEERS INITIALS IN APPROVED BLOCK WHEN A-E IS RESPONSIBLE FOR AMENDMENT OR MODIFICATION.
5. 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.
6. FOR MODIFICATION ONLY:
ADD A $\frac{1}{2}$ INCH ENCIRCLED  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:

CHANGE ORDER #000X (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 IDENTIFICATION NUMBER	PROJECT TITLE PROJECT LOCATION Y Y	R 5	U. S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS	DESIGNED BY:	DATE:	R-4 R-1 A A A A MARK	REVISED TO SHOW AS-BUILT CONDITIONS 08-14-2012								US ARMY CORPS OF ENGINEERS
				DWN BY: CKD BY:	SOLICITATION NO.:		GENERAL REVISIONS 06-17-2012								
				SUBMITTED BY:	CONTRACT NO.:		NEW DRAWING ADDED 03-27-2012								
				FILE NAME:	FILE NUMBER:		REVISED IN ACCORDANCE WITH AM. NO. 0007 03-17-2012								
				SIZE: PLOT SCALE: PLOT DATE:			AM. #0003 GENERAL REVISIONS 02-27-2012								
							AM. #0001 NEW DRAWING ADDED 02-17-2012								
							CHG. ORDER #0001 GENERAL REVISIONS 02-09-2012								
							MARK DESCRIPTION DATE APPR. MARK DESCRIPTION DATE APPR.								

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

M - 2 0 1

SHEET SEQUENCE NUMBER

A/E NAME AND LOCATION INFORMATION

ADDITIONAL PROJECT INFORMATION
IF NEEDED

DRAWING TITLE

DESIGNED BY: INITIALS OF DESIGNER		DATE: CURRENT DATE: MONTH AND YEAR EXAMPLE: JUNE 2012	
DWN BY: INITIALS OF CAD TECH. OR DESIGNER	CKD BY: INITIALS OF REVIEWER	SOLICITATION NO.: THIS NUMBER IS ASSIGNED BY CONTRACTING AND ADDED TO TITLE BLOCK AT THE TIME OF PLOTting ADVERTISEMENT DRAWINGS	
SUBMITTED BY: INITIALS OF REVIEWER/DISCIPLINE SECTION CHIEF		CONTRACT NO.: THIS NUMBER IS ASSIGNED BY CONTRACTING AND ADDED TO TITLE BLOCK AT THE TIME OF PLOTting CONTRACT AWARD DRAWINGS	
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		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	PLOT SCALE: AUTO GENERATED INFORMATION DO NOT EDIT	PLOT DATE: AUTO GENERATED INFORMATION DO NOT EDIT	

* PROJECT CODE:
FOR A/E DESIGN PROJECTS
THIS DESIGNATION IS FOUND
IN THE SCOPE OF WORK

** FILE NUMBER:
FOR A/E DESIGN PROJECTS THIS NUMBER IS FOUND
IN THE SCOPE OF WORK

* PROJECT CODE:
FOR DESIGN BUILD PROJECTS
THIS DESIGNATION IS FOUND IN THE R.F.P.

** FILE NUMBER:
FOR DESIGN BUILD PROJECTS THIS NUMBER IS
FOUND IN THE R.F.P.

—	REVISED TO SHOW AS-BUILT CONDITIONS	08-14-2012	
R-5	REVISED AND REDRAWN	07-03-2012	
R-4	GENERAL REVISIONS	06-17-2012	
R-1	NEW DRAWING ADDED	03-27-2012	
△	REVISED IN ACCORDANCE WITH AM. NO. 0007	03-17-2012	
△	AM. #0003 GENERAL REVISIONS	02-27-2012	
△	AM. #0001 NEW DRAWING ADDED	02-17-2012	
△	CHG. ORDER #0001 GENERAL REVISIONS	02-12-2012	R.W.S.
MARK	DESCRIPTION	DATE	APPR.

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

INITIALS (IF REQUIRED) BY REVIEWER/DISCIPLINE SECTION CHIEF

SHEET IDENTIFICATION NUMBER X	PROJECT TITLE PROJECT LOCATION Y Y X	U. S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS X X X	DESIGNED BY: X	DATE: X	MARK	DESCRIPTION	DATE	APPR.	MARK	DESCRIPTION	DATE	APPR.
			DWN BY: X	CKD BY: X								
			SUBMITTED BY: X	CONTRACT NO.: X								
			FILE NAME: X	FILE NUMBER: X								
			SIZE: X	PLOT SCALE: X	PLOT DATE: X							

U.S. ARMY CORPS
OF ENGINEERS



SHEET 2 of 2

I:\wrkcadd\loddg\loddgAmendMod.dgn

CAD, Drawings, Asbuilt, and Survey Standard

Contract Resource



Buckley AFB - 460th CES - GeoBase

Version 1.0

AS-BUILTS

As-built will be provided in both CAD and PDF formats and submitted to the GeoBase office either electronically using DoD SAFE or burned to a disc and delivered. The PDF will be one file and include a complete set of As-Built files. The PDF will include bookmarks referencing the sheet number and discipline. The PDF will have the following naming convention: YYYYMMDD Project Title. The file date will match the date of the signed as-built.

DRAWINGS/STANDARDS

Drawings shall be submitted as an independent drawing set in accordance with the current version of the CAD/BIM Technology Center for facilities, infrastructure, and environment A/E/C CAD Standard and CAD Drafting Standard. A/E/C CAD Standard Annotation levels/layers shall be set to AutoCAD Index Color #7. (e.g. A-ANNO-TEXT). The file name of each CAD file will match Project name, sheet number and discipline.

Decimal units shall be used for all exterior drawings (site plans, utilities, etc.) more than five (5) feet from the affected facility, or projects that do not affect a building and shall coincide with installation data features. Architectural units shall be used for all interior drawings.

The sheet file shall form the basis for all plotting and exporting functions. Relative paths shall be used for all model file references attached to a sheet set file. Each Layout in a sheet file shall be discipline specific with each discipline's layers visible without manipulation by the user upon opening and be "ready-to-plot". Title blocks and cover sheets developed by the Contractor or provided by the Government shall be present in the AutoCAD Layout (Paper Space) for all sheet files submitted (or model file Layouts for single drawing submissions). Minimum information included in the title block will have the contract number, project number, project title, sheet name, discipline, drawing number, and date.

A cover sheet with an index will be provided. The index will contain the sheet numbers and sheet page. Sheets should be organized by and named by discipline.

SURVEY DATA

Project surveys shall be at an accuracy level of +/- .02 feet. All projects shall clearly indicate survey site control Basis of Bearings statement with the control monuments used to establish that control.

REFERENCE DATUM. As-Built, CAD files, or Survey data shall be horizontally referenced to NAD 83 State Plane Colorado FIPS 0502 Central U.S. Feet Coordinate System and vertical coordinates shall be based on the North American Vertical Datum of 1988 (NAVD 88).

Reference datum and coordinates systems used shall be clearly identified. (Reference: the Geospatial Positioning Accuracy Standards, Part 4; Standards for Architecture, Engineering, Construction (A/E/C), Facility Management (FGDC-STD-007.4-2002)) and ECB 2016-24 Engineering and Construction Bulletin.

SECTION TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 91 00.15 10

TOTAL BUILDING COMMISSIONING

05/19, CHG 2: 08/20

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 SYSTEMS TO BE COMMISSIONED
- 1.3 REFERENCES
- 1.4 COMMUNICATION WITH THE GOVERNMENT
- 1.5 SEQUENCING AND SCHEDULING
 - 1.5.1 Sequencing
 - 1.5.2 Project Schedule
- 1.6 SUBMITTALS
- 1.7 COMMISSIONING FIRM
 - 1.7.1 Lead Commissioning Specialist
 - 1.7.2 Technical Commissioning Specialists
 - 1.7.3 Commissioning Standard
- 1.8 SUSTAINABILITY THIRD PARTY CERTIFICATION (TPC)
- 1.9 ISSUES LOG
- 1.10 CERTIFICATE OF READINESS

PART 2 PRODUCTS

PART 3 EXECUTION

- 3.1 CONSTRUCTION PHASE
 - 3.1.1 Construction Commissioning Coordination Meeting
 - 3.1.2 Construction Phase Commissioning Plan
 - 3.1.2.1 Interim Construction Phase Commissioning Plan
 - 3.1.2.1.1 Checklists
 - 3.1.2.1.2 Template Building Envelope Inspection Checklists
 - 3.1.2.2 Final Construction Phase Commissioning Plan
 - 3.1.2.2.1 Pre-Functional Checklists
 - 3.1.2.2.2 Functional Performance Test Checklists
 - 3.1.3 Design Review
 - 3.1.4 Construction Submittals
 - 3.1.5 Inspection and Testing
 - 3.1.5.1 Commissioning Team
 - 3.1.5.1.1 Building Envelope Inspections Team
 - 3.1.5.1.2 Mechanical System Pre-Functional Checks Team
 - 3.1.5.1.3 Electrical System Pre-Functional Checks Team
 - 3.1.5.1.4 Mechanical Systems Test Team
 - 3.1.5.1.5 Electrical Systems Test Team
 - 3.1.5.2 Building Envelope Inspection
 - 3.1.5.3 Pre-Functional Checks
 - 3.1.5.4 Testing, Adjusting, and Balancing (TAB) Report and Field Acceptance Testing
 - 3.1.5.5 HVAC Controls Test Reports

- 3.1.5.6 Tests
 - 3.1.5.6.1 Functional Performance Tests
 - 3.1.5.6.1.1 Checklist
 - 3.1.5.6.1.2 Acceptance
 - 3.1.5.6.2 HVAC Test Methods
 - 3.1.5.6.2.1 Prior to Testing
 - 3.1.5.6.2.2 Simulating Conditions
 - 3.1.5.6.2.3 Setup
 - 3.1.5.6.3 Sample Strategy
 - 3.1.5.6.4 Seasonal Tests
 - 3.1.5.6.4.1 Initial Functional Performance Tests
 - 3.1.5.6.4.2 Full-Load Conditions
 - 3.1.5.6.4.3 System Acceptance
 - 3.1.5.6.5 Aborted Tests and Re-Testing
 - 3.1.5.6.5.1 100 Percent Sample
 - 3.1.5.6.5.2 Less than 100 Percent Sample
- 3.1.6 Training Plan
- 3.1.7 Systems Manual
- 3.1.8 Maintenance and Service Life Plans
 - 3.1.8.1 Maintenance Plan
 - 3.1.8.2 Service Life Plan
- 3.2 COMMISSIONING REPORT
- 3.3 POST-CONSTRUCTION SUPPORT
 - 3.3.1 Post-Construction Endurance Test
 - 3.3.2 Post-Construction Site Visit

-- 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 SYSTEMS TO BE COMMISSIONED

Commission the following systems:

Heating, Ventilating, Air Conditioning, and Refrigeration Systems (HVAC)
 Building Automation System
 Utility Monitoring and Control System
 Lighting Systems
 Plumbing Systems
 Energy and Water Utility Metering Systems and Sub-Meters
 Building Envelope: include moisture, thermal integrity, and air tightness for the entire building envelope including systems such as walls, fenestration, roofing, roof openings, and slabs-on-grade.

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 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

ER 1110-345-723 Systems Commissioning Procedures

1.4 COMMUNICATION WITH THE GOVERNMENT

The Lead Commissioning Specialist (Cx/C) 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.

1.5 SEQUENCING AND SCHEDULING

1.5.1 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, the Air Barrier Pressure Tests have been completed and the Air Leakage Test Reports and Diagnostic Test Reports have been submitted and approved in accordance with Specification Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.
- 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.

1.5.2 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 in UFGS Section 23 05 93 Specification Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- d. Submission and approval of the Construction Phase Commissioning Plan
- e. Installation of permanent utilities (gas, water, electric)
- f. Building Envelope Construction
- g. Submission and approval of the Building Envelope Inspection Checklists
- h. Air Barrier Pressure Tests specified in Specification Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS
- 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. Post-Test Deficiency Correction for each system to be commissioned
 - cc. Re-Testing
 - dd. Training for each of the systems to be commissioned
 - ee. Systems Manual, submission and approval
 - ff. Submission and approval of the Commissioning Report

- gg. Seasonal Testing
- hh. Post-Construction Endurance Testing
- ii. Post-Construction Site Visit

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 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

- Commissioning Firm; G, RO
- Lead Commissioning Specialist; G, RO
- Technical Commissioning Specialists; G, RO
- Commissioning Firm's Contract; G, DO

SD-06 Test Reports

- Design Review Report; G, DO
- Interim Construction Phase Commissioning Plan; G, RO
- Final Construction Phase Commissioning Plan; G, RO
- Template Building Envelope Inspection Checklists; G, RO
- Building Envelope Inspection Checklists; G, RO
- Pre-Functional Checklists; G, RO
- Issues Log
- Commissioning Report; G, RO
- Post-Construction Trend Log Report; G, RO

SD-07 Certificates

- Certificate of Readiness; G, RO

SD-10 Operation and Maintenance Data

- Training Plan; G, RO
- Training Attendance Rosters; G, RO
- Systems Manual; G, DO
- Maintenance and Service Life Plans; G, RO

SD-11 Closeout Submittals

Final Commissioning Report; S, RO

Final Construction Phase Commissioning Plan; S

1.7 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.
- d. The Commissioning Firm may act as the Pressure Test Agency required by UFGS Section 07 05 23 Specification Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS provided that all qualification requirements of that specification section are met.

1.7.1 Lead Commissioning Specialist

The Commissioning Firm must provide a Lead Commissioning Specialist (Cx/C) 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.

1.7.2 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; Utility Monitoring and Control System; Plumbing Systems; and Energy and Water Utility Metering 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; and Electrical Utility Metering 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. Building Envelope Technical Commissioning Specialist: The technical work associated with the Building Envelope system must be performed by a professional with training and certification as an Air Barrier Installer from the Air Barrier Association of America (ABAA) or other 3rd party air barrier association. The Building Envelope Technical Commissioning Specialist must have experience coordinating and instructing personnel involved in installation, joining, and sealing

of air barrier materials and components. The Commissioning Firm team member with the required experience related to the building envelope may act as the Air Barrier Inspector required by UFGS Section 07 27 10.00 10 Specification Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM provided that all qualification requirements of that specification section are met. The Commissioning Firm team member with the required experience related to the building envelope may act as the thermographer required by UFGS Section 07 05 23 Specification Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS provided that all of the qualification requirements of that specification section are met.

1.7.3 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, ER 1110-345-723, 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.

1.8 SUSTAINABILITY THIRD PARTY CERTIFICATION (TPC)

The Commissioning Specialists must execute and document the commissioning activities required of the Commissioning Authority for the purposes of complying with the Third Party Certification (TPC) requirements for the project in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. Provide all commissioning documentation required to meet the TPC requirements for GBCI guiding principle assessment.

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 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 CONSTRUCTION PHASE

3.1.1 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 Specialists 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.

3.1.2 Construction Phase Commissioning Plan

3.1.2.1 Interim Construction Phase Commissioning Plan

The Lead Commissioning Specialist (Cx) 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.

3.1.2.1.1 Checklists

Download example Building Envelope Inspection Checklists, Pre-Functional 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/ffcc/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.

3.1.2.1.2 Template Building Envelope Inspection Checklists

The Building Envelope Technical Commissioning Specialist must develop the Template Building Envelope Inspection Checklists. Include all items that verify the building materials and construction maintain the required thermal and moisture integrity and air tightness of the building envelope system in the Building Envelope Inspection Checklists.

3.1.2.2 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 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.

3.1.2.2.1 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.

3.1.2.2.2 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 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.

3.1.3 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.

3.1.4 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 and the requirements of the Basis of Design and the Owner's Project Requirements Document.

3.1.5 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 and Functional Performance Tests.

3.1.5.1 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.

3.1.5.1.1 Building Envelope Inspections Team

The following team members must participate in building envelope inspections:

Designation	Function
CxB	Building Envelope Technical Commissioning Specialist
QAR	Contracting Officer's Quality Assurance Representative
CQC	Contractor's Quality Control Personnel
BEC	Contractor's Building Envelope Commissioning Representative

3.1.5.1.2 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

Designation	Function
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

3.1.5.1.3 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

3.1.5.1.4 Mechanical Systems Test Team

The following team members must participate in Functional Performance, Seasonal, 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

3.1.5.1.5 Electrical Systems Test Team

The following team members must participate in Functional Performance Testing 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

3.1.5.2 Building Envelope Inspection

Document building envelope inspection by the commissioning team using the approved Template Building Envelope Inspection Checklists. Indicate commissioning team member inspection and acceptance of each Building Envelope Inspection Checklist item by initials at the time they are inspected and found to be in conformance with contract requirements. Inspect checklist items before they become hidden as construction progresses.

- a. Submit the completed and initialed Building Envelope Inspection Checklists no later than 7 calendar days after completion of inspection of all checklists items. Submit one hard copy and an electronic copy.
- b. The Building Envelope Technical Commissioning Specialist must make at least two site visits to the site to observe construction of the building envelope in-progress. On each visit, the Building Envelope Commissioning Specialist must review the Contractor's in-progress checklists to ensure that the commissioning team is inspecting the building envelope as required.
- c. The Building Envelope Technical Commissioning Specialist must witness the building envelope pressure tests and diagnostic tests specified in Specification Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS. The Building Envelope Technical Commissioning Specialist must review the resulting reports and provide recommendations for correction of any deficiencies or further testing.

3.1.5.3 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 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.

3.1.5.4 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.

3.1.5.5 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.

3.1.5.6 Tests

3.1.5.6.1 Functional Performance 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.

- a. Functional Performance Tests must be performed with the Contracting Officer's Quality Assurance Representative present.
- b. Abort Functional Performance Tests when any system deficiency prevents the successful completion of the test.
- c. Technical Commissioning Specialists must lead and document all Functional Performance Tests for the systems to be commissioned with the Contractor and appropriate sub-contractors performing the Functional Performance Tests. The representatives listed in the paragraph Commissioning Team must attend the tests. Abort Functional Performance Tests when any required commissioning team member is not present for the test.

3.1.5.6.1.1 Checklist

Use the Functional Performance Test Checklists from the approved Final Construction Phase Commissioning Plan to guide the Functional Performance 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 regardless of the specific items listed within the Functional Performance Test provided. Testing must progress from equipment or components to subsystems to systems to interlocks and connections between systems. The order of components and systems to be tested must be determined by the Technical Commissioning Specialists.

3.1.5.6.1.2 Acceptance

Indicate acceptance of each item of equipment and systems tested by signature of each commissioning team member for each Functional Performance Test. The Contractor's Quality Control Representative and the Technical Commissioning Specialists must indicate acceptance after the equipment and systems are free of deficiencies.

3.1.5.6.2 HVAC Test Methods

Perform Functional Performance Tests in accordance with the following:

3.1.5.6.2.1 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.

3.1.5.6.2.2 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.

3.1.5.6.2.3 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.

3.1.5.6.3 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	25
CUH	25
CWP	100

Equipment Identifier	Sample Size (Percent)
DWH	100
Lighting Controls	25
Renewable Energy Systems/Equipment	100

3.1.5.6.4 Seasonal Tests

3.1.5.6.4.1 Initial Functional Performance Tests

Perform Initial Functional Performance Tests as soon as all contract work is completed, regardless of the season. Develop and implement means of artificial loading to demonstrate, to a reasonable level of confidence, the ability of the HVAC systems to handle peak seasonal loads.

3.1.5.6.4.2 Full-Load Conditions

In addition to the Initial Functional Performance Tests, perform Functional Performance Tests of HVAC systems under full-load conditions during peak heating and cooling seasons during outdoor air condition design extremes.

Schedule Seasonal Functional Performance Tests in coordination with the Government.

3.1.5.6.4.3 System Acceptance

Systems may be partially accepted by the Government prior to seasonal testing if they comply with all construction contract that can be tested during initial Functional Performance Tests. All Functional Performance Test procedures must be completed prior to full systems acceptance.

3.1.5.6.5 Aborted Tests and Re-Testing

Abort Functional Performance 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.

3.1.5.6.5.1 100 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.

3.1.5.6.5.2 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.

3.1.6 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.

3.1.7 Systems Manual

Prepare and submit a Systems Manual including a signed certification or letter from the Technical Commissioning Specialists 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. Submit three hard copies and an electronic copy.

3.1.8 Maintenance and Service Life Plans

3.1.8.1 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. Submit three hard copies and an electronic copy.

3.1.8.2 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. Submit three hard copies and an electronic copy.

3.2 COMMISSIONING REPORT

Following the completion of Functional Performance 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 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 Building Envelope Inspection Checklists, Pre-Functional Checklists, Functional Performance 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 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.

3.3 POST-CONSTRUCTION SUPPORT

3.3.1 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, 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.

3.3.2 Post-Construction Site Visit

The Commissioning Specialists must visit the building site concurrent with the 9 month warranty inspection to inspect building system equipment and review building operation with the building operating/maintenance staff. The Commissioning Specialists must identify any deficiency of the building systems to operate in accordance with the contract requirements and the Owner's Project Requirements. The Commissioning Specialists must advise the Contracting Officer's Representative of any identified deficiencies and the proposed corrective action. Submit an updated commissioning report and systems manual documenting the results of the post-construction inspection.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 02 - EXISTING CONDITIONS

SECTION 02 41 00

DEMOLITION

05/10, CHG 2: 02/19

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 PROJECT DESCRIPTION
 - 1.2.1 Definitions
 - 1.2.1.1 Demolition
 - 1.2.1.2 Demolition Plan
 - 1.2.2 Demolition/Deconstruction Plan
 - 1.2.3 General Requirements
- 1.3 ITEMS TO REMAIN IN PLACE
 - 1.3.1 Existing Construction Limits and Protection
 - 1.3.2 Trees
 - 1.3.3 Utility Service
 - 1.3.4 Facilities
- 1.4 BURNING
- 1.5 SUBMITTALS
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Dust and Debris Control
- 1.7 PROTECTION
 - 1.7.1 Traffic Control Signs
 - 1.7.2 Protection of Personnel
- 1.8 RELOCATIONS
- 1.9 EXISTING CONDITIONS

PART 2 PRODUCTS

- 2.1 FILL MATERIAL

PART 3 EXECUTION

- 3.1 EXISTING FACILITIES TO BE REMOVED
 - 3.1.1 Utilities and Related Equipment
 - 3.1.1.1 General Requirements
 - 3.1.1.2 Disconnecting Existing Utilities
 - 3.1.2 Paving and Slabs
- 3.2 CONCURRENT EARTH-MOVING OPERATIONS
- 3.3 DISPOSITION OF MATERIAL
 - 3.3.1 Title to Materials
 - 3.3.2 Reuse of Materials and Equipment
 - 3.3.3 Transportation Guidance
 - 3.3.4 Unsalvageable and Non-Recyclable Material
- 3.4 CLEANUP
- 3.5 DISPOSAL OF REMOVED MATERIALS
 - 3.5.1 Regulation of Removed Materials
 - 3.5.2 Burning on Government Property
 - 3.5.3 Removal from Government Property

-- End of Section Table of Contents --

SECTION 02 41 00

DEMOLITION

05/10, CHG 2: 02/19

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 A10.6 (2006) Safety & Health Program
Requirements for Demolition Operations -
American National Standard for
Construction and Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25 (Jun 2000; Reaffirmed Oct 2010) Storage
and Handling of Liquefied and Gaseous
Compressed Gases and Their Full and Empty
Cylinders
<http://www.aviation.dla.mil/UserWeb/aviationengineerir>

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M (2006) MILSTRIP - Military Standard
Requisitioning and Issue Procedures

MIL-STD-129 (2014; Rev R; Change 1 2018; Change 2
2019) Military Marking for Shipment and
Storage

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1 (2016; Rev L; Change 2) Obstruction
Marking and Lighting

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61 National Emission Standards for Hazardous
Air Pollutants

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 wrecking or taking out any load-supporting structural member of a facility together with any related handling and disposal operations.

1.2.1.2 Demolition Plan

Demolition Plan is the planned steps and processes for managing demolition activities and identifying the required sequencing activities and disposal mechanisms.

1.2.2 Demolition/Deconstruction Plan

Prepare a Demolition Plan and submit proposed salvage, demolition, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Coordinate with Waste Management Plan in accordance with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by the 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 on pavements. The work includes demolition and salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the Contracting Officer. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload 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 Trees

Protect trees within the project site which might be damaged during demolition, and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.3 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and deconstruction 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. 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 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
Existing Conditions

SD-07 Certificates

Notification; G

1.6 QUALITY ASSURANCE

Submit timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M.

Notify the Colorado Department of Public Health and Environment (CDPHE) 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.

1.6.1 Dust and Debris Control

Prevent the spread of dust and debris 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. Sweep pavements as often as necessary to control the spread of debris.

1.7 PROTECTION

1.7.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind. 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. Light construction and installation shall comply with FAA AC 70/7460-1. Lights shall be operational during periods of reduced visibility, darkness, and as directed by the Contracting Officer. Maintain the temporary services during the period of construction.

1.7.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, or other element will be allowed to be left without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.8 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

1.9 EXISTING CONDITIONS

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the

possible conflicting electrical conduits, plumbing lines, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

Provide fill material per the requirements of Section 31 00 00 EARTHWORK.

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Utilities and Related Equipment

3.1.1.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.1.2 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.

3.1.2 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base to a depth of 4 inches below existing adjacent grade. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the Contracting Officer. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition work in areas occupied by structures to be demolished or deconstructed until all demolition in the area has been completed and debris removed. Fill holes, and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, deconstruction, and removal procedures, and authorization by the Contracting Officer to begin demolition and deconstruction. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Reuse of Materials and Equipment

Remove and store materials listed in the Demolition Plan indicated to be reused or relocated to prevent damage, and reinstall as the work progresses. Coordinate the re-use of materials with the re-use requirements in accordance with Section 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL. Capture re-use of materials in the diversion calculations for the project.

3.3.3 Transportation Guidance

Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.3.4 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable combustible material off the site.

3.4 CLEANUP

Remove debris and rubbish. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified in the Waste Management Plan. Storage of removed materials on the project site is prohibited.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted on Government property.

3.5.3 Removal from Government Property

Transport waste materials removed from demolition operations from Government property for legal disposal. Dispose of waste soil as directed.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 03 - CONCRETE

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

02/19, CHG 2: 05/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
- 1.3 SUBMITTALS
- 1.4 MODIFICATION OF REFERENCES
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - 1.5.1 Reinforcement
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Design Data
 - 1.6.1.1 Formwork Calculations
 - 1.6.1.2 Concrete Mix Design
 - 1.6.2 Shop Drawings
 - 1.6.2.1 Formwork
 - 1.6.2.2 Reinforcing Steel
 - 1.6.3 Control Submittals
 - 1.6.3.1 Concrete Curing Plan
 - 1.6.3.2 Pumping Concrete
 - 1.6.3.3 Indoor Air Quality Certification
 - 1.6.3.4 Safety Data Sheets
 - 1.6.4 Test Reports
 - 1.6.4.1 Fly Ash and Pozzolan
 - 1.6.4.2 Slag Cement
 - 1.6.4.3 Aggregates
 - 1.6.5 Quality Control Plan
 - 1.6.6 Quality Control Personnel Certifications
 - 1.6.6.1 Quality Manager Qualifications
 - 1.6.6.2 Field Testing Technician and Testing Agency
 - 1.6.7 Laboratory Qualifications for Concrete Qualification Testing
 - 1.6.8 Laboratory Accreditation
- 1.7 ENVIRONMENTAL REQUIREMENTS
 - 1.7.1 Submittals for Environmental Performance

PART 2 PRODUCTS

- 2.1 FORMWORK MATERIALS
 - 2.1.1 Wood Forms
 - 2.1.1.1 Concrete Form Plywood (Standard Rough)
 - 2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)
 - 2.1.2 Plastic Forms
 - 2.1.3 Carton Forms
 - 2.1.4 Steel Forms
- 2.2 FORMWORK ACCESSORIES
 - 2.2.1 Form Ties
 - 2.2.2 Waterstops
 - 2.2.2.1 PVC Waterstop

- 2.2.2.2 Rubber Waterstop
- 2.2.2.3 Thermoplastic Elastomeric Rubber Waterstop
- 2.2.2.4 Hydrophilic Waterstop
- 2.2.3 Biodegradable Form Release Agent
- 2.2.4 Chamfer Materials
- 2.2.5 Construction and movement joints
- 2.2.6 Other Embedded items
- 2.3 CONCRETE MATERIALS
 - 2.3.1 Cementitious Materials
 - 2.3.1.1 Portland Cement
 - 2.3.1.2 Blended Cements
 - 2.3.1.3 Fly Ash
 - 2.3.1.4 Slag Cement
 - 2.3.1.5 Other Supplementary Cementitious Materials
 - 2.3.2 Water
 - 2.3.3 Aggregate
 - 2.3.3.1 Normal-Weight Aggregate
 - 2.3.3.2 Lightweight Aggregate
 - 2.3.3.3 Recycled Aggregate Materials
 - 2.3.4 Admixtures
- 2.4 MISCELLANEOUS MATERIALS
 - 2.4.1 Concrete Curing Materials
 - 2.4.2 Nonshrink Grout
 - 2.4.3 Floor Finish Materials
 - 2.4.3.1 Liquid Chemical Floor Hardeners and Sealers
 - 2.4.4 Expansion/Contraction Joint Filler
 - 2.4.5 Joint Sealants
 - 2.4.5.1 Horizontal Surfaces, 3 Percent Slope, Maximum
 - 2.4.5.2 Vertical Surfaces Greater Than 3 Percent Slope
 - 2.4.5.3 Preformed Polychloroprene Elastomeric Type
 - 2.4.5.4 Lubricant for Preformed Compression Seals
 - 2.4.6 Vapor Retarder
- 2.5 CONCRETE MIX DESIGN
 - 2.5.1 Properties and Requirements
 - 2.5.2 Durability
 - 2.5.2.1 Alkali-Aggregate Reaction
 - 2.5.2.2 Freezing and Thawing Resistance
 - 2.5.2.3 Corrosion and Chloride Content
 - 2.5.2.4 Sulfate Resistance
 - 2.5.2.5 Concrete Temperature
 - 2.5.2.6 Concrete permeability
 - 2.5.3 Trial Mixtures
 - 2.5.4 Ready-Mix Concrete
- 2.6 REINFORCEMENT
 - 2.6.1 Reinforcing Bars
 - 2.6.1.1 Headed Reinforcing Bars
 - 2.6.1.2 Bar Mats
 - 2.6.1.3 Headed Shear Stud Reinforcement
 - 2.6.2 Mechanical Reinforcing Bar Connectors
 - 2.6.3 Reinforcing Bar Supports
 - 2.6.4 Dowels for Load Transfer in Floors

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
 - 3.2.1 General
 - 3.2.2 Subgrade Under Foundations and Footings
 - 3.2.3 Subgrade Under Slabs on Ground

- 3.2.4 Edge Forms and Screed Strips for Slabs
- 3.2.5 Reinforcement and Other Embedded Items
- 3.3 FORMS
 - 3.3.1 Coating
 - 3.3.2 Reuse
 - 3.3.3 Forms for Standard Rough Form Finish
 - 3.3.4 Forms for Standard Smooth Form Finish
 - 3.3.5 Form Ties
 - 3.3.6 Tolerances for Form Construction
 - 3.3.7 Removal of Forms and Supports
 - 3.3.8 Strength of Concrete Required for Removal of Formwork
- 3.4 WATERSTOP INSTALLATION AND SPLICES
 - 3.4.1 PVC Waterstop
 - 3.4.2 Rubber Waterstop
 - 3.4.3 Thermoplastic Elastomeric Rubber Waterstop
 - 3.4.4 Hydrophilic Waterstop
- 3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS
 - 3.5.1 General
 - 3.5.2 Vapor Retarder
 - 3.5.3 Perimeter Insulation
 - 3.5.4 Reinforcement Supports
 - 3.5.5 Splicing
 - 3.5.6 Future Bonding
 - 3.5.7 Setting Miscellaneous Material
 - 3.5.8 Fabrication
 - 3.5.9 Placing Reinforcement
 - 3.5.10 Spacing of Reinforcing Bars
 - 3.5.11 Concrete Protection for Reinforcement
- 3.6 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE
 - 3.6.1 Measuring
 - 3.6.2 Mixing
 - 3.6.3 Transporting
- 3.7 PLACING CONCRETE
 - 3.7.1 Pumping
 - 3.7.2 Cold Weather
 - 3.7.3 Hot Weather
 - 3.7.4 Bonding
- 3.8 WASTE MANAGEMENT
 - 3.8.1 Mixing Equipment
 - 3.8.2 Hardened, Cured Waste Concrete
 - 3.8.3 Reinforcing Steel
 - 3.8.4 Other Waste
- 3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES
 - 3.9.1 Defects
 - 3.9.2 Not Against Forms (Top of Walls)
 - 3.9.3 Formed Surfaces
 - 3.9.3.1 Tolerances
 - 3.9.3.2 As-Cast Rough Form
 - 3.9.3.3 Standard Smooth Finish
- 3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION
 - 3.10.1 Finish
 - 3.10.1.1 Scratched
 - 3.10.1.2 Floated
 - 3.10.1.3 Steel Troweled
 - 3.10.1.4 Broomed
 - 3.10.1.5 Pavement
 - 3.10.1.6 Chemical-Hardener Treatment
 - 3.10.2 Flat Floor Finishes
 - 3.10.2.1 Measurement of Floor Tolerances

- 3.10.2.2 Remedies for Out of Tolerance Work
- 3.10.3 Concrete Walks
- 3.10.4 Pits and Trenches
- 3.10.5 Curbs and Gutters
- 3.11 JOINTS
 - 3.11.1 Construction Joints
 - 3.11.1.1 Maximum Allowable Construction Joint Spacing
 - 3.11.1.2 Construction Joints for Constructability Purposes
- 3.12 CONCRETE FLOOR TOPPING
 - 3.12.1 Standard Floor Topping
 - 3.12.1.1 Preparations Prior to Placing
 - 3.12.1.2 Placing
 - 3.12.1.3 Finishing
- 3.13 CURING AND PROTECTION
 - 3.13.1 Curing Periods
 - 3.13.2 Curing Formed Surfaces
 - 3.13.3 Curing Unformed Surfaces
 - 3.13.4 Temperature of Concrete During Curing
 - 3.13.5 Protection from Mechanical Injury
 - 3.13.6 Protection After Curing
- 3.14 FIELD QUALITY CONTROL
 - 3.14.1 Aggregate Testing
 - 3.14.1.1 Fine Aggregate
 - 3.14.1.2 Coarse Aggregate
 - 3.14.2 Concrete Sampling
 - 3.14.3 Concrete Testing
 - 3.14.3.1 Slump Tests
 - 3.14.3.2 Temperature Tests
 - 3.14.3.3 Compressive Strength Tests
 - 3.14.3.4 Air Content
 - 3.14.3.5 Unit Weight of Structural Concrete
 - 3.14.3.6 Chloride Ion Concentration
 - 3.14.3.7 Strength of Concrete Structure
 - 3.14.3.8 Non-Conforming Materials
 - 3.14.3.9 Testing Concrete Structure for Strength
- 3.15 REPAIR, REHABILITATION AND REMOVAL
 - 3.15.1 Repair of Weak Surfaces
 - 3.15.2 Failure of Quality Assurance Test Results

-- End of Section Table of Contents --

SECTION 03 30 00

CAST-IN-PLACE CONCRETE
02/19, CHG 2: 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 CONCRETE INSTITUTE (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 121R	(2008) Guide for Concrete Construction Quality Systems in Conformance with ISO 9001
ACI 301	(2016) Specifications for Structural Concrete
ACI 302.1R	(2015) Guide for Concrete Floor and Slab Construction
ACI 304.2R	(2017) Guide to Placing Concrete by Pumping Methods
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306R	(2016) Guide to Cold Weather Concreting
ACI 308.1	(2011) Specification for Curing Concrete
ACI 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
------------	--------------------------------

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A184/A184M	(2019) Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A934/A934M	(2016) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A970/A970M	(2018) Standard Specification for Headed Steel Bars for Concrete Reinforcement
ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1044/A1044M	(2016a) Standard Specification for Steel Stud Assemblies for Shear Reinforcement of Concrete
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2021a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	(2020) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C78/C78M	(2021) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM 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	(2020) Standard Specification for Portland Cement
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a; R 2016) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C311/C311M	(2018) Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use in Portland-Cement Concrete
ASTM C330/C330M	(2017a) Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C567/C567M	(2019) Determining Density of Structural Lightweight Concrete
ASTM C595/C595M	(2020) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2019) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C803/C803M	(2018) Standard Test Method for Penetration Resistance of Hardened Concrete
ASTM C845/C845M	(2018) Standard Specification for Expansive Hydraulic Cement
ASTM C873/C873M	(2015) Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
ASTM C900	(2015) Standard Test Method for Pullout Strength of Hardened Concrete
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants

ASTM C989/C989M	(2018a) Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C1012/C1012M	(2018b) Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution
ASTM C1017/C1017M	(2013; E 2015) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1074	(2019) Standard Practice for Estimating Concrete Strength by the Maturity Method
ASTM C1077	(2017) Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1157/C1157M	(2020a) Standard Performance Specification for Hydraulic Cement
ASTM C1218/C1218M	(2020c) Standard Test Method for Water-Soluble Chloride in Mortar and Concrete
ASTM C1240	(2020) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	(2021) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)
ASTM C1293	(2008; R 2015) Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction
ASTM C1567	(2021) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C1602/C1602M	(2018) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C1778	(2016) Standard Guide for Reducing the Risk of Deleterious Alkali-Aggregate Reaction in Concrete
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D471	(2016a) Standard Test Method for Rubber

Property - Effect of Liquids

ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM 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	(2016) Standard Test Methods for Water Vapor Transmission 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

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(2009) DOC Voluntary Product Standard PS
-----------	--

1-07, Structural Plywood

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1113 (2016) Architectural Coatings

U.S. ARMY CORPS OF ENGINEERS (USACE)

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

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings

1.2 DEFINITIONS

- a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, and slag cement.
- b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.
- c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.
- d. "Supplementary cementing materials" (SCM) include coal fly ash, slag cement, natural or calcined pozzolans, and ultra-fine coal ash when used in such proportions to replace the portland cement that result in improvement to sustainability and durability and reduced cost.
- e. "Design strength" (f'c) is the specified compressive strength of concrete at time(s) specified in this section to meet structural design criteria.
- f. "Mass Concrete" is any concrete system that approaches a maximum temperature of 158 degrees F within the first 72 hours of placement. In addition, it includes all concrete elements with a section thickness of 3 feet or more regardless of temperature.
- g. "Mixture proportioning" is the process of designing concrete mixture proportions to enable it to meet the strength, service life and constructability requirements of the project while minimizing the initial and life-cycle cost.

- h. "Mixture proportions" are the masses or volumes of individual ingredients used to make a unit measure (cubic meter or cubic yard) of concrete.
- i. "Pozzolan" is a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.
- j. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Concrete Curing Plan

Quality Control Plan; G

Quality Control Personnel Certifications; G

Quality Control Organizational Chart

Laboratory Accreditation; G

Maturity Method Data

SD-02 Shop Drawings

Formwork

Reinforcing Steel; G, AE

SD-03 Product Data

Joint Sealants; S

Joint Filler

Formwork Materials

Recycled Aggregate Materials; S

Cementitious Materials; S

Vapor Retarder

Concrete Curing Materials

Recycled Content for Steel Reinforcement; S

Liquid Chemical Floor Hardeners and Sealers

Admixtures

Mechanical Reinforcing Bar Connectors

Waterstops

Biodegradable Form Release Agent; S

Pumping Concrete

Nonshrink Grout

SD-04 Samples

SD-05 Design Data

Concrete Mix Design; G

Formwork Calculations

SD-06 Test Reports

Concrete Mix Design; G

Fly Ash

Pozzolan

Slag Cement

Aggregates

Tolerance Report

Compressive Strength Tests; G

Unit Weight of Structural Concrete

Chloride Ion Concentration

Air Content

Slump Tests

Water

SD-07 Certificates

Reinforcing Bars

Indoor Air Quality for Joint Sealants and Adhesives; S

Indoor Air Quality for Concrete Curing Compound; S

Indoor Air Quality for Waterproofing Sealer; S

Indoor Air Quality for Form Release Agent; S

Indoor Air Quality Certification

Safety Data Sheets

Field Testing Technician and Testing Agency

SD-08 Manufacturer's Instructions

Liquid Chemical Floor Hardeners and Sealers

Joint Sealants

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. For previously approved concrete mix designs used within the past twelve months, the previous mix design may be re-submitted without further trial batch testing if accompanied by material test data conducted within the last six months. Obtain mix design approval from the contracting officer prior to concrete placement.

1.6.2 Shop Drawings

1.6.2.1 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.

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 Indoor Air Quality Certification

Provide products certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold or other third-party program and VOC content requirements of Green Seal GS-11, California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings, or SCAQMD Rule 1113. Submit product data for indoor air quality for joint sealants and adhesives, indoor air quality for concrete curing compound, indoor air quality for waterproofing sealer, and indoor air quality for form release agent.

1.6.3.4 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 pre-consumer pozzolan (fly ash, slag cement) cement substitution as a percentage of the full product composite by weight.
- b. Provide data indicating the percentage of pre-consumer and post-consumer recycled content aggregate.
- c. Provide product data indicating the percentage of post-consumer recycled content for steel reinforcement in each type of steel reinforcement as a percentage of the full product composite by weight.
- d. Provide SDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.
- e. Provide SDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

PART 2 PRODUCTS

2.1 FORMWORK MATERIALS

- a. Form-facing material in contact with concrete must be lumber, plywood, tempered concrete-form-grade hardboard, metal, plastic, or treated paper that creates specified appearance and texture of concrete surface. Submit product information on proposed form-facing materials if different from that specified herein.
- b. Design formwork and shores to support loads transmitted to them and to comply with applicable building code requirements.
- c. Design formwork to withstand pressure resulting from placement and

vibration of concrete and to maintain specified tolerances.

- d. Design formwork to accommodate waterstop materials in joints at locations indicated in Contract Documents.
- e. Provide temporary openings in formwork if needed to facilitate cleaning and inspection.
- f. Design formwork joints to inhibit leakage of mortar.
- g. Limit deflection of facing materials for concrete surfaces exposed to view to 1/240 of center-to-center spacing of facing supports.
- h. Do not use earth cuts as forms for vertical or sloping surfaces.
- i. Submit product information on proposed form-facing materials if different from that specified herein.
- j. Submit shop drawings for formwork and shoring. Shop drawings must be signed and sealed by a licensed design engineer.
- k. Submit design calculations for formwork and shoring. Design calculations must be signed and sealed by a licensed design engineer.
- l. Submit manufacturer's product data on form liner proposed for use with each formed surface.

2.1.1.1 Wood Forms

Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with NIST PS 1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Submit data verifying that composite wood products contain no urea formaldehyde resins. Virgin wood used must be FSC-certified.

2.1.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Plastic Forms

Plastic lumber as specified in Section 06 10 00 ROUGH CARPENTRY. Provide plastic forms that contain a minimum of 50 percent post-consumer recycled content, or a minimum of 50 percent post-industrial recycled content.

2.1.3 Carton Forms

Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete until initial set. Provide carton forms that contain a minimum of 5 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content.

2.1.4 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORMWORK ACCESSORIES

- a. Use commercially manufactured formwork accessories, including ties and hangers.
- b. Form ties and accessories must not reduce the effective cover of the reinforcement.

2.2.1 Form Ties

- a. Use form ties with ends or end fasteners that can be removed without damage to concrete.
- b. Where indicated in Contract Documents, use form ties with integral water barrier plates or other acceptable positive water barriers in walls.
- c. The breakback distance for ferrous ties must be at least 3/4 in. for Surface Finish-2.0 or Surface Finish-3.0, as defined in ACI 301.
- d. If the breakback distance is less than 3/4 in., use coated or corrosion-resistant ties.
- e. Submit manufacturer's data sheet on form ties.

2.2.2 Waterstops

Submit manufacturer's data sheet on waterstop materials and splices.

2.2.2.1 PVC Waterstop

Polyvinylchloride waterstops must conform to COE CRD-C 572.

2.2.2.2 Rubber Waterstop

Rubber waterstops must conform to COE CRD-C 513.

2.2.2.3 Thermoplastic Elastomeric Rubber Waterstop

Thermoplastic elastomeric rubber waterstops must conform to ASTM D471.

2.2.2.4 Hydrophilic Waterstop

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water must conform to the following requirements when tested in accordance to ASTM D412: Tensile strength 420 psi minimum; ultimate elongation 600 percent minimum. Hardness must be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 70 degrees F must be 3 to 1 minimum.

2.2.3 Biodegradable Form Release Agent

- a. Provide form release agent that is colorless, biodegradable, and

water-based, with a low (maximum of 55 grams/liter (g/l)) VOC content.

- b. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
- c. Provide form release agent that reduces formwork moisture absorption, and does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene. Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.
- d. Submit manufacturer's product data on formwork release agent for use on each form-facing material.

2.2.4 Chamfer Materials

Use lumber materials with dimensions of 3/4 x 3/4 in.

2.2.5 Construction and movement joints

- a. Submit details and locations of construction joints in accordance with the requirements herein.
- b. Locate construction joints within middle one-third of spans of slabs, beams, and girders. If a beam intersects a girder within the middle one-third of girder span, the distance between the construction joint in the girder and the edge of the beam must be at least twice the width of the larger member.
- c. Locate construction joints in walls and columns at underside of slabs, beams, or girders and at tops of footings or slabs.
- d. Make construction joints perpendicular to main reinforcement.
- e. Provide movement joints where indicated in Contract Documents or in accepted alternate locations.
- f. Submit location and detail of movement joints if different from those indicated in Contract Documents.
- g. Submit manufacturer's data sheet on expansion joint materials.
- h. Provide keyways where indicated in Contract Documents.

2.2.6 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 I, II.

- b. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.
- c. Supplier must certify that no hazardous waste is used in the fuel mix or raw materials.
- d. Submit information along with evidence demonstrating compliance with referenced standards. Submittals must include types of cementitious materials, manufacturing locations, shipping locations, and certificates showing compliance.
- e. Cementitious materials must be stored and kept dry and free from contaminants.

2.3.1.2 Blended Cements

- a. Blended cements must conform to ASTM C595/C595M Type IP, IS, IP(MS), IS(MS), or ASTM C1157/C1157M Type GU or MS.
- b. Slag cement added to the Type IS blend must meet ASTM C989/C989M.
- c. The pozzolan added to the Type IP blend must be ASTM C618 Class F fly ash and must be interground with the cement clinker. The manufacturer must state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot-to-lot or within a lot. The percentage and type of pozzolan used in the blend must not change from that submitted for the aggregate evaluation and mixture proportioning.

2.3.1.3 Fly Ash

- a. ASTM C618, Class F , except that the maximum allowable loss on ignition must not exceed 3 percent.
- b. If fly ash is used it shall range from 15 to 20 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.

2.3.1.4 Slag Cement

ASTM C989/C989M, Grade 100 .

2.3.1.5 Other Supplementary Cementitious Materials

Natural pozzolan must be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling ASR and must have an ignition loss not exceeding 3 percent. Class N pozzolan for use in mitigating ASR must have a Calcium Oxide (CaO) content of less than 13 percent and total equivalent alkali content less than 3 percent.

Ultra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) must conform to ASTM C618, Class F or N, and the following additional requirements:

- a. The strength activity index at 28 days of age must be at least 95 percent of the control specimens.
- b. The average particle size must not exceed 6 microns.
- c. The sum of $\text{SiO}_2 + \text{Al}_2\text{O}_3 + \text{Fe}_2\text{O}_3$ must be greater than 77 percent.

2.3.2 Water

- a. Water or ice must comply with the requirements of ASTM C1602/C1602M.
- b. Minimize the amount of water in the mix. Improve workability by adjusting the grading of the aggregate and using admixture rather than by adding water.
- c. Water must be potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.
- d. Protect mixing water and ice from contamination during storage and delivery.
- e. Submit test report showing water complies with ASTM C1602/C1602M.

2.3.3 Aggregate

2.3.3.1 Normal-Weight Aggregate

- a. Aggregates must conform to ASTM C33/C33M unless otherwise specified in the Contract Documents or approved by the contracting officer.
- b. Aggregates used in concrete must be obtained from the same sources and have the same size range as aggregates used in concrete represented by submitted field test records or used in trial mixtures.
- c. Provide sand that is at least 50 percent natural sand.
- d. Store and handle aggregate in a manner that will avoid segregation and prevents contamination by other materials or other sizes of aggregates. Store aggregates in locations that will permit them to drain freely. Do not use aggregates that contain frozen lumps.
- e. Submit types, pit or quarry locations, producers' names, aggregate supplier statement of compliance with ASTM C33/C33M, and ASTM C1293 expansion data not more than 18 months old.

2.3.3.2 Lightweight Aggregate

Lightweight aggregate in accordance with ASTM C330/C330M.

2.3.3.3 Recycled Aggregate Materials

Use a minimum of 25 percent recycled aggregate, depending on local availability and conforming to requirements of the mix design. Recycled aggregate to include: recovered glass, recovered concrete, recovered porcelain, and recovered stone that meets the aggregate requirements specified. Submit recycled material request with the aggregate certification submittals and do not use until approved by the Contracting

Officer.

2.3.4 Admixtures

- a. Chemical admixtures must conform to ASTM C494/C494M.
- b. Air-entraining admixtures must conform to ASTM C260/C260M.
- c. Chemical admixtures for use in producing flowing concrete must conform to ASTM C1017/C1017M.
- d. Do not use calcium chloride admixtures.
- e. Use a corrosion-inhibiting admixture for concrete classified under exposure category C1 and 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.

2.4.4 Expansion/Contraction Joint Filler

ASTM D1751 or ASTM D1752 Type I or Type II. Material must be 1/2 inch thick, unless otherwise indicated.

2.4.5 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 A polyethylene sheeting, minimum 10 mil thickness or other equivalent material with a maximum permance 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.

2.5 CONCRETE MIX DESIGN

2.5.1 Properties and Requirements

- a. Use materials and material combinations listed in this section and the contract documents.
- b. Cementitious material content must be adequate for concrete to satisfy the specified requirements for strength, w/cm, durability, and finishability described in this section and the contract documents.

The minimum cementitious material content for concrete used in floors must meet the following requirements:

Nominal maximum size of aggregate, in.	Minimum cementitious material content, pounds per cubic yard
1-1/2	470
1	520

Nominal maximum size of aggregate, in.	Minimum cementitious material content, pounds per cubic yard
3/4	540
3/8	610

- c. Selected target slump must meet the requirements this section, the contract documents, and must not exceed 9 in. Concrete must not show visible signs of segregation.
- d. The target slump must be enforced for the duration of the project. Determine the slump by ASTM C143/C143M. Slump tolerances must meet the requirements of ACI 117.
- e. The nominal maximum size of coarse aggregate for a mixture must not exceed three-fourths of the minimum clear spacing between reinforcement, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.
- f. Concrete must be air entrained for members assigned to Exposure Class F1, F2, or F3. The total air content must be in accordance with the requirements of the paragraph titled DURABILITY.
- g. Measure air content at the point of delivery in accordance with ASTM C173/C173M or ASTM C231/C231M.
- h. Concrete for slabs to receive a hard-troweled finish must not contain an air-entraining admixture or have a total air content greater than 3 percent.
- i. Concrete properties and requirements for each portion of the structure are specified in the table below. Refer to the paragraph titled DURABILITY for more details on exposure categories and their requirements.

	Minimum $f'c$ psi	Exposure Categories^	Miscellaneous Requirements
Driller Piers, Pier Caps, Grade Beams, and Foundation Walls	5000 at 28 days	S1; C1; W1; F1	
Slabs on Metal Deck	4000 at 28 days	S0; C0; W0; F0	Nominal maximum aggregate size must be 3/4 in.

	Minimum $f'c$ psi	Exposure Categories^	Miscellaneous Requirements
Suspended Slabs	5000 at 28 days	S0; C0; W0; F0	Nominal maximum aggregate size must be 3/4 in.
Structural Stoops	5000 at 28 days	S1; C2; W1; F3	

2.5.2 Durability

2.5.2.1 Alkali-Aggregate Reaction

Do not use any aggregate susceptible to alkali-carbonate reaction (ACR). Use one of the three options below for qualifying concrete mixtures to reduce the potential of alkali-silica reaction (ASR):

- For each aggregate used in concrete, the expansion result determined in accordance with ASTM C1293 must not exceed 0.04 percent at one year.
- For each aggregate used in concrete, the expansion result of the aggregate and cementitious materials combination determined in accordance with ASTM C1567 must not exceed 0.10 percent at an age of 16 days.
- Alkali content in concrete (LBA) must not exceed 4 pounds per cubic yard for moderately reactive aggregate or 3 pounds per cubic yard for highly reactive aggregate. Reactivity must be determined by testing in accordance with ASTM C1293 and categorized in accordance with ASTM C1778. Alkali content is calculated as follows:

$$\text{LBA} = (\text{cement content, pounds per cubic yard}) \times (\text{equivalent alkali content of portland cement in percent}/100 \text{ percent})$$

2.5.2.2 Freezing and Thawing Resistance

- Provide concrete meeting the following requirements based on exposure class assigned to members for freezing-and-thawing exposure in Contract Documents:

Exposure class	Maximum w/cm^*	Minimum $f'c$, psi	Air content	Additional Requirements
F0	N/A	2500	N/A	
F1	0.55	3500	Depends on aggregate size	N/A

Exposure class	Maximum w/cm^*	Minimum $f'c$, psi	Air content	Additional Requirements
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

*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*^	IP(MS); IS(<70)(MS); IT(MS)	MS	No restrictions

* 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.

^ 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

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

*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:

- Type and brand cement
- Cement and supplementary cementitious materials content in 94-pound bags per cubic yard of concrete
- Maximum size of aggregate
- Amount and brand name of admixtures
- Total water content expressed by water cementitious material ratio

2.6 REINFORCEMENT

- Bend reinforcement cold. Fabricate reinforcement in accordance with fabricating tolerances of ACI 117.
- When handling and storing coated reinforcement, use equipment and methods that do not damage the coating. If stored outdoors for more than 2 months, cover coated reinforcement with opaque protective material.
- Submit manufacturer's certified test report for reinforcement.
- 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.
- Submit request with locations and details of splices not indicated in Contract Documents.

- f. Submit request to place column dowels without using templates.
- g. Submit request and procedure to field-bend or straighten reinforcing bars partially embedded in concrete at locations not indicated in Contract Documents. Field bending or straightening of reinforcing bars is permitted where indicated in the Contract Documents
- h. 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; or ASTM A996/A996M with the bars marked R, Grade 60, or marked A, Grade 40 or 60. Cold drawn wire used for spiral reinforcement must conform to ASTM A1064/A1064M.
- c. Recycled Content of Steel Reinforcement: Provide at minimum 25 percent post-consumer recycled content. Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product.
- d. Submit mill certificates for reinforcing bars.

2.6.1.1 Headed Reinforcing Bars

Headed reinforcing bars must conform to ASTM A970/A970M including Annex A1, and other specified requirements.

2.6.1.2 Bar Mats

- a. Bar mats must conform to ASTM A184/A184M.

2.6.1.3 Headed Shear Stud Reinforcement

Headed studs and headed stud assemblies must conform to ASTM A1044/A1044M.

2.6.2 Mechanical Reinforcing Bar Connectors

- a. Provide 125 percent minimum yield strength of the reinforcement bar.
- b. Mechanical splices for galvanized reinforcing bars must be galvanized or coated with dielectric material.
- d. Submit data on mechanical splices demonstrating compliance with this paragraph.

2.6.3 Reinforcing Bar Supports

- a. Provide reinforcement support types within structure as required by Contract Documents. Reinforcement supports must conform to CRSI RB4.1. Submit description of reinforcement supports and materials for fastening coated reinforcement if not in conformance with CRSI RB4.1.
- b. Legs of supports in contact with formwork must be hot-dip galvanized,

or plastic coated after fabrication, or stainless-steel bar supports.

2.6.4 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.

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. Do not bevel reentrant corners or edges of formed joints of concrete.
- c. Provide formwork with clean-out openings to permit inspection and removal of debris.
- d. Inspect formwork and remove foreign material before concrete is placed.
- e. At construction joints, lap form-facing materials over the concrete of previous placement. Ensure formwork is placed against hardened concrete so offsets at construction joints conform to specified tolerances.
- f. Provide positive means of adjustment (such as wedges or jacks) of shores and struts. Do not make adjustments in formwork after concrete has reached initial setting. Brace formwork to resist lateral deflection and lateral instability.
- g. Fasten form wedges in place after final adjustment of forms and before concrete placement.

- h. Provide anchoring and bracing to control upward and lateral movement of formwork system.
- i. Construct formwork for openings to facilitate removal and to produce opening dimensions as specified and within tolerances.
- j. Provide runways for moving equipment. Support runways directly on formwork or structural members. Do not support runways on reinforcement. Loading applied by runways must not exceed capacity of formwork or structural members.
- k. Position and support expansion joint materials, waterstops, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with removable material to prevent concrete entry into voids.
- 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 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.

3.3.3 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.

3.3.4 Forms for Standard Smooth Form Finish

Provide formwork in accordance with ACI 301 Section 5 with a surface finish, SF-3.0, for formed surfaces that are exposed to view. Do not provide mockup of concrete surface appearance and texture.

3.3.5 Form Ties

- a. For post-tensioned structures, do not remove formwork supports until stressing records have been accepted by the Contracting Officer.

- b. After ends or end fasteners of form ties have been removed, repair tie holes in accordance with ACI 301 Section 5 requirements.

3.3.6 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.

3.3.7 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.

3.3.8 Strength of Concrete Required for Removal of Formwork

If removal of formwork is based on concrete reaching a specified in-place strength, mold and field-cure cylinders in accordance with ASTM C31/C31M. Test cylinders in accordance with ASTM C39/C39M. Alternatively, use one or more of the methods listed herein to evaluate in-place concrete strength for formwork removal.

- a. Tests of cast-in-place cylinders in accordance with ASTM C873/C873M. This option is limited to slabs with concrete depths from 5 to 12 in.
- b. Penetration resistance in accordance with ASTM C803/C803M.

- c. Pullout strength in accordance with ASTM C900.
- d. Maturity method in accordance with ASTM C1074. Submit maturity method data using project materials and concrete mix proportions used on the project to demonstrate the correlation between maturity and compressive strength of laboratory cured test specimens to the Contracting Officer.

3.4 WATERSTOP INSTALLATION AND SPLICES

- a. Provide waterstops in construction joints as indicated.
- b. Install formwork to accommodate waterstop materials. Locate waterstops in joints where indicated in Contract Documents. Minimize number of splices in waterstop. Splice waterstops in accordance with manufacturer's written instructions. Install factory-manufactured premolded mitered corners.
- c. Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Protect waterstops protruding from joints from damage.

3.4.1 PVC Waterstop

Make splices by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. Reform waterstops at splices with a remolding iron with ribs or corrugations to match the pattern of the waterstop. The spliced area, when cooled, must show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.4.2 Rubber Waterstop

Rubber waterstops must be spliced using cold bond adhesive as recommended by the manufacturer.

3.4.3 Thermoplastic Elastomeric Rubber Waterstop

Fittings must be shop made using a machine specifically designed to mechanically weld the waterstop. A portable power saw must be used to miter or straight cut the ends to be joined to ensure good alignment and contact between joined surfaces. Maintain continuity of the characteristic features of the cross section of the waterstop (for example ribs, tabular center axis, and protrusions) across the splice.

3.4.4 Hydrophilic Waterstop

Miter cut ends to be joined with sharp knife or shears. The ends must be adhered with adhesive.

3.5 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

- a. Unless otherwise specified, placing reinforcement and miscellaneous materials must be in accordance to ACI 301. Provide bars, welded wire reinforcement, wire ties, supports, and other devices necessary to install and secure reinforcement.
- b. Reinforcement must not have rust, scale, oil, grease, clay, or foreign

substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

- c. Nonprestressed cast-in-place concrete members must have concrete cover for reinforcement given in the following table:

Concrete Exposure	Member	Reinforcement	Specified cover, in.
Cast against and permanently in contact with ground	All	All	3
Exposed to weather or in contact with ground	All	No. 6 through No. 18 bars	2
		No. 5 bar, W31 or D31 wire, and smaller	1-1/2
Not exposed to weather or in contact with ground	Slabs, joists, and walls	No. 14 and No. 18 bars	1-1/2
		No. 11 bar and smaller	3/4
	Beams, columns, pedestals, and tension ties	Primary reinforcement, stirrups, ties, spirals, and hoops	1-1/2

3.5.1 General

Provide details of reinforcement that are in accordance with the Contract Documents.

3.5.2 Vapor 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.

3.5.3 Perimeter Insulation

Install perimeter insulation at locations indicated. Adhesive must be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.5.4 Reinforcement Supports

Provide reinforcement support in accordance with CRSI RB4.1 and ACI 301 Section 3 requirements. Supports for coated or galvanized bars must also be coated with electrically compatible material for a distance of at least 2 inches beyond the point of contact with the bars.

3.5.5 Splicing

As indicated in the Contract Documents. For splices not indicated follow ACI 301. Do not splice at points of maximum stress. Overlap welded wire reinforcement the spacing of the cross wires, plus 2 inches.

3.5.6 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.

3.6 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. Reduce mixing time and 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. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture, within the manufacturer's recommended dosage, to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch. Do not reconstitute concrete that has begun to solidify.

3.6.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.7 PLACING CONCRETE

Place concrete in accordance with ACI 301 Section 5. Concrete shall be

placed within 15 minutes of discharge into non-agitating equipment.

3.7.1 Pumping

ACI 304R and ACI 304.2R. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches at discharge/placement. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of coarse aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well-rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.7.2 Cold Weather

Cold weather concrete must meet the requirements of ACI 301 unless otherwise specified. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.7.3 Hot Weather

Hot weather concrete must meet the requirements of ACI 301 unless otherwise specified. Maintain required concrete temperature using Figure 4.2 in ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.7.4 Bonding

Surfaces of set concrete at joints, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

- a. At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of

fresh concrete.

- b. At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.
- c. Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

3.8 WASTE MANAGEMENT

Provide as specified in the Waste Management Plan and as follows.

3.8.1 Mixing Equipment

Before concrete pours, designate Contractor-owned site meeting environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.8.2 Hardened, Cured Waste Concrete

Use hardened, cured waste concrete as aggregate in concrete mix if approved by Contracting Officer.

3.8.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.8.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Return excess cement to supplier. Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

3.9 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. 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 exterior slabs where not otherwise specified. Finish concrete in accordance with ACI 301 Section 5 for a floated finish.

3.10.1.3 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.

3.10.1.4 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Finish concrete in accordance with ACI 301 Section 5 for a broomed finish.

3.10.1.5 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but

gritty nonslip surface is obtained. Round edges and joints with an edger having a radius of 1/8 inch.

3.10.1.6 Chemical-Hardener Treatment

Apply liquid-chemical floor hardener where indicated after curing and drying concrete surface. Dilute liquid hardener with water and apply in three coats. First coat must be one-third strength, second coat one-half strength, and third coat two-thirds strength. Apply each coat evenly and allow to dry 24 hours between coats.

Approved proprietary chemical hardeners must be applied in accordance with manufacturer's printed directions.

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 Conventional Value:

Floor Flatness (Ff) 20 13 minimum
Floor Levelness (FL) 15 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 and Gutters

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.

3.11 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 Maximum Allowable Construction Joint Spacing

- a. In walls at not more than 60 feet in any horizontal direction.

3.11.1.2 Construction Joints for Constructability Purposes

- a. In walls, at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall.
- b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier.
- c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

3.12 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.

3.13 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 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.

3.13.2 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders,

beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.13.3 Curing Unformed Surfaces

- a. Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.
- b. Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.13.4 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.13.5 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.13.6 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, and hold two cylinder in reserve. Take samples for strength tests of each mix design of concrete placed each day

not less than once a day, nor less than once for each 100 cubic yards of concrete for the first 500 cubic yards, then every 500 cubic yards thereafter, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. Concrete compressive tests must meet the requirements of this section, the Contract Document, and ACI 301. Retest locations represented by erratic core strengths. Where retest does not meet concrete compressive strength requirements submit a mitigation or remediation plan for review and approval by the contracting officer. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.14.3.4 Air Content

ASTM C173/C173M or ASTM C231/C231M for normal weight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.14.3.5 Unit Weight of Structural Concrete

ASTM C567/C567M and ASTM C138/C138M. Determine unit weight of lightweight and 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.
- e. Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

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 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.

3.15.2 Failure of Quality Assurance Test Results

Proposed mitigation efforts by the Contractor must be approved by the Contracting Officer prior to proceeding.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 04 - MASONRY

SECTION 04 20 00

UNIT MASONRY

11/15, CHG 2: 05/19

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY ASSURANCE
 - 1.3.1 Shop Drawings
 - 1.3.2 Masonry Mock-Up Panels
 - 1.3.2.1 Mock-Up Panel Location
 - 1.3.2.2 Mock-Up Panel Configuration
 - 1.3.2.3 Mock-Up Panel Composition
 - 1.3.2.4 Mock-Up Panel Construction Method
 - 1.3.2.5 Mock-Up Panel Purpose
 - 1.3.3 Special Masonry Inspector Qualifications
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - 1.4.1 Masonry Units
 - 1.4.2 Reinforcement, Anchors, and Ties
 - 1.4.3 Cementitious Materials, Sand and Aggregates
- 1.5 PROJECT/SITE CONDITIONS
 - 1.5.1 Hot Weather Procedures
 - 1.5.2 Cold Weather Procedures

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Design - Specified Compressive Strength of Masonry
 - 2.1.2 Performance - Verify Masonry Compressive Strength
- 2.2 MANUFACTURED UNITS
 - 2.2.1 General Requirements
 - 2.2.2 Concrete Units
 - 2.2.2.1 Aggregates
 - 2.2.2.2 Concrete Masonry Units (CMU)
 - 2.2.2.2.1 Cement
 - 2.2.2.2.2 Recycled Content
 - 2.2.2.2.3 Size
 - 2.2.2.2.4 Surfaces
 - 2.2.2.2.5 Weather Exposure
 - 2.2.2.2.6 Unit Types
 - 2.2.2.2.7 Jamb Units
 - 2.2.2.3 Architectural Units
 - 2.2.2.4 Patterned, Decorative Screen Units
 - 2.2.2.5 Fire-Rated Concrete Masonry Units
 - 2.2.3 Precast Concrete Units
 - 2.2.3.1 General
 - 2.2.3.2 Precast Concrete Lintels
- 2.3 EQUIPMENT
 - 2.3.1 Vibrators

- 2.3.2 Grout Pumps
- 2.4 MATERIALS
 - 2.4.1 Mortar Materials
 - 2.4.1.1 Cementitious Materials
 - 2.4.1.2 Hydrated Lime and Alternates
 - 2.4.1.3 Colored Mortar
 - 2.4.1.4 Admixtures for Masonry Mortar
 - 2.4.1.5 Aggregate and Water
 - 2.4.2 Grout and Ready-Mix Grout Materials
 - 2.4.2.1 Cementitious Materials for Grout
 - 2.4.2.2 Admixtures for Grout
 - 2.4.2.3 Aggregate and Water
- 2.5 MORTAR AND GROUT MIXES
 - 2.5.1 Mortar Mix
 - 2.5.2 Grout and Ready Mix Grout Mix
- 2.6 ACCESSORIES
 - 2.6.1 Grout Barriers
 - 2.6.2 Anchors, Ties, and Bar Positioners
 - 2.6.2.1 General
 - 2.6.2.2 Wire Mesh Anchors
 - 2.6.2.3 Wall Ties for Multi-Wythe Masonry Construction
 - 2.6.2.4 Adjustable Anchors
 - 2.6.2.4.1 Anchorage to Structural Steel
 - 2.6.2.4.2 Anchorage of Veneer to Light Gauge Steel or Concrete Backing
 - 2.6.2.5 Veneer Anchor Screws
 - 2.6.2.6 Bar Positioners
 - 2.6.3 Joint Reinforcement
 - 2.6.4 Reinforcing Steel Bars
 - 2.6.5 Concrete Masonry Control Joint Keys
 - 2.6.6 Through Wall Flashing and Weeps
 - 2.6.6.1 General
 - 2.6.6.2 Stainless Steel Flashing
 - 2.6.6.3 Rubberized Flashing
 - 2.6.6.4 Weep Ventilators
 - 2.6.6.5 Single-Wythe Exterior Wall CMU Flashing System
 - 2.6.6.6 Metal Drip Edge
 - 2.6.7 RIGID BOARD-TYPE INSULATION

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
 - 3.2.1 Stains
 - 3.2.2 Loads
 - 3.2.3 Concrete Surfaces
 - 3.2.4 Shelf Angles
 - 3.2.5 Bracing
- 3.3 ERECTION
 - 3.3.1 General
 - 3.3.1.1 Jointing
 - 3.3.1.1.1 Tooled Joints
 - 3.3.1.1.2 Flush Joints
 - 3.3.1.1.3 Door and Window Frame Joints
 - 3.3.1.1.4 Joint Widths
 - 3.3.1.2 Cutting and Fitting
 - 3.3.1.3 Unfinished Work
 - 3.3.1.4 Control Joints
 - 3.3.1.5 Decorative Architectural Units

- 3.3.2 Anchored Veneer Construction
- 3.3.3 Reinforced, Single Wythe Concrete Masonry Units Walls
 - 3.3.3.1 Concrete Masonry Unit Placement
 - 3.3.3.2 Preparation for Reinforcement
- 3.3.4 ANCHORAGE
 - 3.3.4.1 Anchorage to Concrete
 - 3.3.4.2 Anchorage to Structural Steel
 - 3.3.4.3 Anchorage at Intersecting Walls
- 3.3.5 Lintels
 - 3.3.5.1 Masonry Lintels
 - 3.3.5.2 Precast Concrete and Steel Lintels
- 3.3.6 Sills and Copings
- 3.4 INSTALLATION
 - 3.4.1 Bar Reinforcement Installation
 - 3.4.1.1 Preparation
 - 3.4.1.2 Positioning Bars
 - 3.4.1.3 Splices of Bar Reinforcement
 - 3.4.2 Placing Grout
 - 3.4.2.1 General
 - 3.4.2.2 Vertical Grout Barriers for Multi-Wythe Composite Walls
 - 3.4.2.3 Horizontal Grout Barriers
 - 3.4.2.4 Grout Holes and Cleanouts
 - 3.4.2.4.1 Grout Holes
 - 3.4.2.4.2 Cleanouts for Hollow Unit Masonry Construction
 - 3.4.2.4.3 Cleanouts for Multi-Wythe Composite Masonry Construction
 - 3.4.2.5 Grout Placement
 - 3.4.3 Joint Reinforcement Installation
 - 3.4.4 Bond Beams
 - 3.4.5 Flashing and Weeps
- 3.5 APPLICATION
 - 3.5.1 Insulation
 - 3.5.2 Interface with Other Products
 - 3.5.2.1 Built-In Items
 - 3.5.2.2 Door and Window Frame Joints
 - 3.5.2.3 Bearing Plates
 - 3.5.3 Tolerances
- 3.6 FIELD QUALITY CONTROL
 - 3.6.1 Tests
 - 3.6.1.1 Field Testing of Mortar
 - 3.6.1.2 Field Testing of Grout
 - 3.6.1.3 Prism Tests
 - 3.6.2 Special Inspection
- 3.7 POINTING AND CLEANING
 - 3.7.1 Dry-Brushing Concrete Masonry
- 3.8 CLOSE-OUT TAKE-BACK PROGRAM
- 3.9 PROTECTION

-- End of Section Table of Contents --

SECTION 04 20 00

UNIT MASONRY

11/15, CHG 2: 05/19

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

- | | |
|-----------|---|
| ACI 216.1 | (2014) Code Requirements for Determining Fire Resistance of Concrete and Masonry Construction Assemblies |
| 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 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 A167 | (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip |
| ASTM A185/A185M | (2007) Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete |
| ASTM A615/A615M | (2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement |
| ASTM A641/A641M | (2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire |
| ASTM A653/A653M | (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process |
| ASTM A951/A951M | (2011) Standard Specification for Steel Wire for Masonry Joint Reinforcement |

ASTM A996/A996M	(2016) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM A1008/A1008M	(2020) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C90	(2016) Standard Specification for Loadbearing Concrete Masonry Units
ASTM C129	(2017) Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C207	(2018) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C270	(2019) Standard Specification for Mortar for Unit Masonry
ASTM C476	(2020) Standard Specification for Grout for Masonry
ASTM C494/C494M	(2019) Standard Specification for Chemical Admixtures for Concrete
ASTM C641	(2017) Standard Test Method for Iron Staining Materials in Lightweight Concrete Aggregates
ASTM C780	(2020) Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C979/C979M	(2016) Standard Specification for Pigments for Integrally Colored Concrete
ASTM C1019	(2019) Standard Test Method for Sampling and Testing Grout
ASTM C1314	(2014) Standard Test Method for Compressive Strength of Masonry Prisms
ASTM C1384	(2012a) Standard Specification for Admixtures for Masonry Mortars
ASTM C1611/C1611M	(2014) 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 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

Cut CMU Drawings; G

Reinforcement Detail Drawings; G

SD-03 Product Data

Concrete masonry units (cmu) face and sill units; G

Reinforcement, Anchors, and Ties; G

Hot Weather Procedures; G

Cold Weather Procedures; G

Cement; G

Cementitious Materials; G

Recycled Content for Steel Reinforcement; S

Recycled Content for Concrete Masonry Units; S

SD-04 Samples

Mock-Up Panel; G

Concrete Masonry Units (CMU); G

Admixtures for Masonry Mortar; G

SD-05 Design Data

Masonry Compressive Strength; G

Fire-Rated Concrete Masonry Units

Bracing Calculations; G

SD-06 Test Reports

Fire-Rated Concrete Masonry Units

Field Testing of Mortar

Field Testing of Grout

Prism Tests

SD-07 Certificates

Special Masonry Inspector Qualifications

Concrete Masonry Units (CMU)

Precast Concrete Units

Cementitious Materials

Admixtures for Masonry Mortar

Admixtures for Grout

Anchors, Ties, and Bar Positioners

Joint Reinforcement

Insulation

SD-08 Manufacturer's Instructions

Admixtures for Masonry Mortar

Admixtures for Grout

SD-10 Operation and Maintenance Data

Take-Back Program

SD-11 Closeout Submittals

Recycled Content of Cement; S

1.3 QUALITY ASSURANCE

1.3.1 Shop Drawings

Submit drawings showing elevations of walls exposed to view and indicating the location of all CMU products.

1.3.2 Masonry Mock-Up Panels

1.3.2.1 Mock-Up Panel Location

After material samples are approved and prior to starting masonry work,

construct a mock-up panel for each type and color of masonry required. At least 48 hours prior to constructing the panel or panels, submit written notification to the Contracting Officer. Do not build-in mock-up panels as part of the structure; locate mock-up panels where directed. Construct portable mock-up panels or locate in an area where they will not be disrupted during construction.

1.3.2.2 Mock-Up Panel Configuration

Construct mock-up panels L-shaped or otherwise configured to represent all of the wall elements. Construct panels of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. Provide a straight panel or a leg of an L-shaped panel of minimum size 8 feet long by 6 feet high.

1.3.2.3 Mock-Up Panel Composition

Show full color range, texture, and bond pattern of the masonry work. Demonstrate mortar joint tooling; grouting of reinforced vertical cores, collar joints, bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work during the construction of the panels. Also include installation or application procedures for anchors, wall ties, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weeps. Include a a masonry bonded corner, a bond beam corner, and installation of electrical boxes and conduit. When the panel represents reinforced masonry, include a 2 by 2 foot opening placed at least 2 feet above the panel base and 2 feet away from all free edges, corners, and control joints. Provide required reinforcing around this opening as well as at wall corners and control joints.

1.3.2.4 Mock-Up Panel Construction Method

Where anchored veneer walls or cavity walls are required, demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Demonstrate provisions to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. When water-repellent is specified to be applied to the masonry, apply the approved product to the mock-up panel. Construct panels on a properly designed concrete foundation.

1.3.2.5 Mock-Up Panel Purpose

The completed panels is used as the standard of workmanship for the type of masonry represented. Do not commence masonry work until the mock-up panel for that type of masonry construction has been completed and approved. Protect panels from the weather and construction operations until the masonry work has been completed and approved. Perform cleaning procedures on the mockup and obtain approval of the Contracting Officer prior to cleaning the building. After completion of the work, completely remove the mock-up panels, including all foundation concrete, from the construction site.

1.3.3 Special Masonry Inspector Qualifications

Refer to Section 01 45 35 SPECIAL INSPECTIONS for qualifications and responsibilities of the masonry special inspector.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, store, handle, and protect material to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.4.1 Masonry Units

Cover and protect masonry units from precipitation. Conform to handling and storage requirements of TMS MSJC.

- a. Pack glazed brick, glazed structural clay tile, and prefaced concrete masonry units in the manufacturer's standard paper cartons, trays, or shrink wrapped pallets with a divider between each unit. Do not stack pallets. Do not remove units from cartons until cartons are placed on scaffolds or in the location where units are to be laid.
- b. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.4.2 Reinforcement, Anchors, and Ties

Store steel reinforcing bars, coated anchors, ties, and joint reinforcement above the ground. Maintain steel reinforcing bars and uncoated ties free of loose mill scale and loose rust.

1.4.3 Cementitious Materials, Sand and Aggregates

Deliver cementitious and other packaged materials in unopened containers, plainly marked and labeled with manufacturers' names and brands. Store cementitious material in dry, weathertight enclosures or completely cover. Handle cementitious materials in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination and segregation.

1.5 PROJECT/SITE CONDITIONS

Conform to TMS MSJC for hot and cold weather masonry erection.

1.5.1 Hot Weather Procedures

When ambient air temperature exceeds 100 degrees F, or exceeds 90 degrees F and the wind velocity is greater than 8 mph, comply with TMS MSJC Article 1.8 D for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly completed masonry.

1.5.2 Cold Weather Procedures

When ambient temperature is below 40 degrees F, comply with TMS MSJC Article 1.8 C for: preparation prior to conducting masonry work; construction while masonry work is in progress; and protection for newly

completed masonry.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design - Specified Compressive Strength of Masonry

The specified compressive strength of masonry, $f'm$, is as indicated on the design drawings.

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.

2.2.2.2 Concrete Masonry Units (CMU)

2.2.2.2.1 Cement

Use only cement that has a low alkali content and is of one brand.

2.2.2.2.2 Recycled Content

Provide units with a minimum of 10 percent post-consumer recycled content, or a minimum of 40 percent pre-consumer recycled content, based on mass, cost, or volume. Submit product data for recycled content for concrete masonry units.

2.2.2.2.3 Size

Provide units with specified dimensions, as follows:

- a. Structural:
 - 1. 7 5/8" inches wide, 7 5/8" inches high, 11 5/8" inches long
- b. Face CMU:
 - 1. 3 5/8" inches wide, 3 5/8" inches high, 23 5/8" inches long
 - 2. 3 5/8" inches wide, 7 5/8" inches high, 23 5/8" inches long
 - 3. 3 5/8" inches wide, 11 5/8" inches high, 23 5/8" inches long
- c. Window Sills
 - 1. Manufacturer's standard sill as indicated.

2.2.2.2.4 Surfaces

Provide units with exposed surfaces that are smooth and of uniform texture, unless indicated otherwise on the drawings.

2.2.2.2.5 Weather Exposure

Provide concrete masonry units with water-repellant admixture added during manufacture where units will be exposed to weather.

2.2.2.2.6 Unit Types

- a. Hollow Load-Bearing Units: ASTM C90, lightweight. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.
- b. Hollow Non-Load-Bearing Units: ASTM C129, lightweight. Load-bearing units may be provided in lieu of non-load-bearing units.
- c. Solid Load-Bearing Units: ASTM C90, lightweight or medium weight or normal weight units. Provide solid units as indicated.

2.2.2.2.7 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 Architectural Units

Provide architectural units with patterned face shell: as indicated.

Provide units that are integrally colored with natural aggregates during manufacture, with color as indicated.

2.2.2.4 Patterned, Decorative Screen Units

Provide patterned, decorative screen units that conform to ASTM C90 . Provide units that have uniform through-the-wall pattern, color, and texture.

2.2.2.5 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.

2.2.3 Precast Concrete Units

2.2.3.1 General

- a. Provide precast concrete copings that are factory-made units in a plant regularly engaged in producing precast concrete units. Unless otherwise indicated, provide precast concrete with minimum 3000 psi compressive strength, conforming to Section 03 30 00 CAST-IN-PLACE CONCRETE using 1/2 inch to No. 4 nominal-size coarse aggregate, and with reinforcement required for handling of the units. Maintain minimum clearance of 3/4 inch between reinforcement and faces of units.
- b. Unless precast-concrete items have been subjected during manufacture to saturated-steam pressure of at least 120 psi for at least 5 hours, either damp-cure for 24 hours or steam-cure and then age under cover for 28 days or longer. In precast concrete members weighing over 80 pounds provide built-in loops of galvanized wire or other approved provisions for lifting and anchoring.
- c. Fabricate units with beds and joints at right angles to the face, with sharp true arises and with drip grooves on the underside where units overhang walls. Form exposed-to-view surfaces free of surface voids, spalls, cracks, and chipped or broken edges and with uniform appearance and color. Unless otherwise specified, provide units with

a smooth dense finish.

- d. Prior to installation, wet and inspect each unit for crazing. Items showing evidence of dusting, spalling, crazing, or having surfaces treated with a protective coating will be rejected.
- e. Submit specified factory certificates.
- f. Provide architectural cast stone masonry trim, copings, heads, and sills that are manufactured in a plant by a producer regularly engaged in producing cast stone. Provide cast stone units that comply with ASTM C1364. Submit test reports and three exemplars of the same cast stone product installed in similar projects in similar climatic conditions.

2.2.3.2 Precast Concrete Lintels

Provide precast concrete lintels, unless otherwise shown, of a thickness equal to the wall and reinforced with minimum two No. 4 bars for the full length. Provide top and bottom bars for lintels over 36 inches in length. Provide at least 8 inches bearing at each end. Label the top of lintels and clearly mark each lintel to show location in the structure. Design reinforced lintels in conformance with ACI 318 for flexural and shear strength, using concrete with a minimum 28 day compressive strength of 3,000 psi. Limit lintel deflection due to dead plus live load to $L/600$ or 0.3 inches.

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 Colored Mortar

Use mortar pigment that conforms to ASTM C979/C979M. Add pigment to mortar to produce a uniform color matching as indicated. Furnish pigments in accurately pre-measured and packaged units that can be added to a measured amount of cementitious materials or supply pigments via preblended cementitious materials or dry mortar mix.

- a. In masonry cement or mortar cement, do not exceed 5 percent of cement weight for mineral oxide pigment; do not exceed 1 percent of cement weight for carbon black pigment.
- b. In cement-lime mortar mix, do not exceed 10 percent of cementitious materials' weight for mineral oxide pigment; do not exceed 2 percent of cementitious materials' weight for carbon black pigment.

2.4.1.4 Admixtures for Masonry Mortar

In cold weather, use a non-chloride based accelerating admixture that conforms to ASTM C1384, unless Type III portland cement is used in the mortar.

In showers and kitchens, use mortar that contains a water-repellent admixture that conforms to ASTM C1384. Provide a water-repellent admixture, conforming to ASTM C1384 and of the same brand and manufacturer as the block's integral water-repellent, in the mortar used to place concrete masonry units that have an integral water-repellent admixture.

2.4.1.5 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 S unless specified otherwise herein. Do not use masonry cement in the mortar. Do not use air-entrainment in the mortar.
- b. Use ASTM C270 Type S cement-lime mortar or mortar cement mortar for seismic-force-resisting elements indicated.
- c. Provide Type S mortar for non-load-bearing, non-shear-wall interior

masonry.

- d. 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.
- e. 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. 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 3,000 psi in 28 days, as tested in accordance with ASTM C1019. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that grout meets the specified requirements. Use ready-mixed grout that conforms to ASTM C476.

2.6 ACCESSORIES

2.6.1 Grout Barriers

Grout barriers for vertical cores that consist of fine mesh wire, fiberglass, or expanded metal.

2.6.2 Anchors, Ties, and Bar Positioners

2.6.2.1 General

- a. Fabricate anchors and ties without drips or crimps. Size anchors and ties to provide a minimum of 5/8 inch mortar cover from each face of masonry.
- b. Fabricate steel wire anchors and ties shall from wire conforming to ASTM A1064/A1064M and hot-dip galvanize in accordance with ASTM A153/A153M.
- c. Fabricate joint reinforcement in conformance with ASTM A951/A951M. Hot dip galvanize joint reinforcement in exterior walls and in interior walls exposed to moist environment in conformance with ASTM A153/A153M. Galvanize joint reinforcement in other interior walls in conformance with ASTM A641/A641M; coordinate with paragraph JOINT REINFORCEMENT below.
- d. Fabricate sheet metal anchors and ties in conformance with ASTM A1008/A1008M. Hot dip galvanize sheet metal anchors and ties in exterior walls and in interior walls exposed to moist environment in compliance with ASTM A153/A153M Class B. Galvanize sheet metal anchors and ties in other interior walls in compliance with ASTM A653/A653M, Coating Designation G60.
- e. Submit two anchors, ties and bar positioners of each type used, as

samples.

2.6.2.2 Wire Mesh Anchors

Provide wire mesh anchors of 1/4 inch mesh galvanized hardware cloth, conforming to ASTM A185/A185M, with length not less than 12 inches, at intersections of interior non-bearing masonry walls.

2.6.2.3 Wall Ties for Multi-Wythe Masonry Construction

Provide rectangular-shaped wall ties, fabricated of hot-dipped galvanized W1.7 diameter steel wire. Provide rectangular wall ties no less than 4 inches wide.

Provide adjustable type wall ties, if approved for use, that consist of two essentially U-shaped elements fabricated of minimum W2.8 diameter steel wire or pintle type ties that are inserted to eyes of horizontal joint reinforcement, hot-dip galvanized. Provide adjustable ties with double pintle legs and allows a maximum offset of 1-1/4 inch between each element of the tie and maximum distance between connecting parts no more than 1/16 inch. Form the pintle and eye elements shall be formed so that both can be in the same plane. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT.

2.6.2.4 Adjustable Anchors

2.6.2.4.1 Anchorage to Structural Steel

Provide hot-dip galvanized adjustable anchors for connecting masonry walls to the structural steel frame as detailed on the drawings. Provide zinc-rich paint for touching up paint after welding galvanized anchors to structural steel.

2.6.2.4.2 Anchorage of Veneer to Light Gauge Steel or Concrete Backing

Use one of the following types of adjustable anchors to connect veneer to light gauge steel or concrete backing:

- a. sheet metal at least 7/8 inch wide, 0.06 inch thick, and with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch or bent, notched or punched to provide equivalent performance;
- b. wire anchors of minimum size W1.7 with ends bent to form a minimum 2 inches extension and without drips;
- c. or wire pintle anchors used in conjunction with joint reinforcement.

Do not exceed 1/16 inch clearance between connecting parts of the tie. Assemble adjustable anchors to prevent disengagement. Provide pintle anchors with one or more pintle legs of wire size W2.8 and an offset not exceeding 1-1/4 inch.

2.6.2.5 Veneer Anchor Screws

Provide screws for attachment of veneer anchors to cold-formed steel framing members of size as required by design to provide the needed pullout load capacity but not less than No. 12. Provide length of screws such that the screws penetrate the holding member by not less than 5/8 inch.

2.6.2.6 Bar Positioners

Factory-fabricate bar positioners, used to prevent displacement of reinforcing bars during the course of construction, from 9 gauge steel wire or equivalent, and hot-dip galvanized. Bar positioners must be suitable for intended use and be corrosion resistant steel. Bar positioners not fully contained within the wythe must be hot-dip galvanized.

2.6.3 Joint Reinforcement

Factory fabricate joint reinforcement in conformance with ASTM A951/A951M, welded construction. Provide ladder type joint reinforcement, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units and with all wires a minimum of 9 gauge. Size joint reinforcement to provide a minimum of 5/8 inch cover from each face. Space crosswires not more than 16 inches. Provide joint reinforcement for straight runs in flat sections not less than 10 feet long. Provide joint reinforcement with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features. Submit one piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

2.6.4 Reinforcing Steel Bars

Reinforcing steel bars and rods shall conform to ASTM A615/A615M or ASTM A996/A996M, Grade 60. Provide minimum 45 percent post-consumer recycled content, or minimum 90 percent pre-consumer recycled content. Submit product data for recycled content for steel reinforcement.

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.

2.6.6 Through Wall Flashing and Weeps

2.6.6.1 General

Provide stainless steel sheet and except that the material shall be one which is not adversely affected by dampproofing material.

2.6.6.2 Stainless Steel Flashing

Provide stainless steel, ASTM A167, Type 304 or 316, 0.015 inch thick, No. 2D finish. Where indicated, provide with factory-fabricated deformations that mechanically bond flashing against horizontal movement in all directions, where deformations consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations.

2.6.6.3 Rubberized Flashing

Provide self-adhesive rubberized asphalt sheet flashing consisting of 32-mil thick pliable and highly adhesive rubberized asphalt compound bonded completely and integrally to 8-mil thick, high density, cross-laminated polyethylene film to produce an overall thickness of 40 mils. Provide rubberized, asphalt-based mastic and surface conditioner that are each approved by flashing manufacturer for use with flashing material.

2.6.6.4 Weep Ventilators

Provide weep ventilators that are prefabricated from stainless steel or plastic. Provide inserts with grill or louver-type openings designed to allow the passage of moisture from cavities and to prevent the entrance of insects, and with a rectangular closure strip to prevent mortar droppings from clogging the opening. Provide ventilators with compressible flanges to fit in a standard 3/8 inch wide mortar joint and with height equal to the nominal height of the unit.

2.6.6.5 Single-Wythe Exterior Wall CMU Flashing System

In single-wythe exterior CMU walls, provide a system of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. For exterior CMU walls, provide a flashing/weep system in open cores that do not receive grout. Cell flashing pans are to have integral weep spouts built into mortar bed joints that extend into the cell to prevent clogging with mortar.

2.6.6.6 Metal Drip Edge

Provide stainless steel drip edge, 15-mil thick, hemmed edges, with down-turned drip at the outside edge and upturned dam at the inside edge for use with membrane flashings.

2.6.7 RIGID BOARD-TYPE INSULATION

Provide rigid board-type insulation as specified in Section 07 21 13 BOARD AND BLOCK INSULATION.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to start of work, verify the applicable conditions as set forth in TMS MSJC, inspection.

3.2 PREPARATION

3.2.1 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.2.2 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for

at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.2.3 Concrete Surfaces

Where masonry is to be placed, clean concrete of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.4 Shelf Angles

Adjust shelf angles as required to keep the masonry level and at the proper elevation.

3.2.5 Bracing

Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by OSHA and local codes and 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 the indicated 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.

- e. In multi-wythe construction with collar joints no more than 3/4 inch wide, bring up the inner wythe not more than 16 inches ahead of the outer wythe. Fill collar joints with mortar during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by back-buttering each unit as it is laid.

3.3.1.1 Jointing

Tool mortar joints when the mortar is thumbprint hard. Tool horizontal joints after tooling vertical joints. Brush mortar joints to remove loose and excess mortar.

3.3.1.1.1 Tooled Joints

Tool mortar joints in exposed exterior and interior masonry surfaces concave, using a jointer that is slightly larger than the joint width so that complete contact is made along the edges of the unit. Perform tooling so that the mortar is compressed and the joint surface is sealed. Use a jointer of sufficient length to obtain a straight and true mortar joint. No exterior joints are to be left un-tooled.

3.3.1.1.2 Flush Joints

Flush cut mortar joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas. Finish flush cut joints by cutting off the mortar flush with the face of the wall. Point joints in unparged masonry walls below grade tight. For architectural units, such as fluted units, completely fill both the head and bed joints and flush cut.

3.3.1.1.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.3.1.1.4 Joint Widths

- a. Construct brick masonry with mortar joint widths equal to the difference between the specified and nominal dimensions of the unit, within tolerances permitted by TMS MSJC.
- b. Provide 3/8 inch wide mortar joints in concrete masonry, except for prefaced concrete masonry units.
- c. Provide 3/8 inch wide mortar joints on unfaced side of prefaced concrete masonry units and not less than 3/16 inch nor more than 1/4 inch wide on prefaced side.
- d. Maintain mortar joint widths within tolerances permitted by TMS MSJC

3.3.1.2 Cutting and Fitting

Use full units of the proper size wherever possible, in lieu of cut units. Locate cut units where they would have the least impact on the architectural aesthetic goals of the facility. Perform cutting and

fitting, including that required to accommodate the work of others, by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Before being placed in the work, dry wet-cut units to the same surface-dry appearance as uncut units being laid in the wall. Provide cut edges that are clean, true and sharp.

- a. Carefully make openings in the masonry so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Provide reinforced masonry lintels above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.
- b. Do not reduce masonry units in size by more than one-third in height and one-half in length. Do not locate cut products at ends of walls, corners, and other openings.

3.3.1.3 Unfinished Work

Rack back unfinished work for joining with new work. 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 open end stretcher units placed with the closed end at the joint in accordance with the details shown on the Drawings. Form a continuous vertical joint at control joint locations, including through bond beams, by utilizing half blocks in alternating courses on each side of the joint. Interrupt the control joint key in courses containing continuous bond beam reinforcement. Do not interrupt the horizontal reinforcement and grout at the control joint.

Where mortar was placed in the joint, rake both faces of the control joints to a depth of 3/4 inch. Install backer rod and sealant on both faces in accordance with Section 07 92 00 JOINT SEALANTS.

3.3.1.5 Decorative Architectural Units

Place decorative masonry units with the patterned face shell properly aligned in the completed wall.

3.3.2 Anchored Veneer Construction

- a. Construct exterior masonry wythes to the thickness indicated on the drawings. Provide a minimum 2 inch air space behind the masonry veneer. Provide means to ensure that the cavity space and flashings are kept clean of mortar droppings and other loose debris. Maintain chases and raked-out joints free from mortar and debris.
- b. Place masonry in running bond pattern.
- c. For veneer over stud framing, do not install veneer until the exterior sheathing, moisture barrier, veneer anchors and flashing have been installed on the backing. Take extreme care to avoid damage to the moisture barrier and flashing during construction of the masonry veneer. Repair or replace portions of the moisture barrier and

flashing that are damaged prior to completion of the veneer. Provide a continuous cavity as indicated.

- d. For veneer with a masonry backup wythe, lay up both the inner and the outer wythes together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, install through-wall flashings with the exterior wythe, securing the top edge of the flashing with a termination bar and sealant, or protect flashings that are installed with the interior wythe from damage until they are fully enclosed in the wall.
- e. Provide anchors (ties) to connect the veneer to its backing in sufficient quantity to comply with the following requirements: maximum wall area per anchor {tie} of 2.67 ft², and maximum vertical spacing of 24 inches, and maximum horizontal spacing of 32 inches. Provide additional anchors around openings larger than 16 inch in either direction. Space anchors around perimeter of opening at a maximum of 24 inches on center. Place anchors within 12 inches of openings. Anchors with drips are not permitted.
- f. With solid units, embed anchors in mortar joint and extend into the veneer a minimum of 1-1/2 inch, with at least 5/8 inch mortar cover to the outside face.
- g. With hollow units, embed anchors in mortar or grout and extend into the veneer a minimum of 1-1/2 inch, with at least 5/8 inch mortar or grout cover to outside face.

3.3.3 Reinforced, Single Wythe Concrete Masonry Units Walls

3.3.3.1 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.

3.3.3.2 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.

3.3.4 ANCHORAGE

3.3.4.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 16 inches on centers vertically and 24 inches on center horizontally.

3.3.4.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 16 inches on centers vertically, and if applicable, not over 24 inches on centers horizontally.

3.3.4.3 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 bond beams and horizontal joint reinforcement as indicated, overlapping masonry units, and strap anchors of minimum size 1/4 inch x 1-1/2 inch x 28 inches including 2 inch) 90 degree bends at each end to form U or Z shape at maximum spacing 48 inches, grouted into the wall, unless the drawings indicate a movement joint at the intersection.

3.3.5 Lintels

3.3.5.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 5 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.

3.3.5.2 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.

3.3.6 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. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Provide minimum clearance between parallel bars of 1/2 inch between the bars and masonry units for coarse grout and a minimum clearance of 1/4 inch between the bars and masonry units for fine grout. Provide minimum clearance between parallel bars of 1 inch or one diameter of the reinforcement, whichever is greater. Vertical reinforcement may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement or by other means to prevent displacement beyond permitted tolerances. As masonry work progresses, secure vertical reinforcement to prevent displacement beyond allowable tolerances.
- b. Wire column and pilaster lateral ties in position around the vertical reinforcing bars. Place lateral ties in contact with the vertical reinforcement and do not place in horizontal mortar bed joints.
- c. Position horizontal reinforcing bars as indicated. Stagger splices in adjacent horizontal bars, unless otherwise indicated.
- d. Form splices by lapping bars as indicated. Do not cut, bend or eliminate reinforcing bars. Foundation dowel bars may be field-bent when permitted by TMS MSJC.

3.4.1.3 Splices of Bar Reinforcement

Lap splice reinforcing bars as indicated. When used, provide welded or mechanical connections that develop at least 125 percent of the specified yield strength of the reinforcement.

3.4.2 Placing Grout

3.4.2.1 General

Fill cells containing reinforcing bars with grout. Solidly grout hollow

masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces. Solidly grout cells under lintel bearings on each side of openings for full height of openings. Solidly grout walls below grade, lintels, and bond beams. Units other than open end units may require grouting each course to preclude voids in the units.

Discard site-mixed grout that is not placed within 1-1/2 hours after water is first added to the batch or when the specified slump is not met without adding water after initial mixing. Discard ready-mixed grout that does not meet the specified slump without adding water other than water that was added at the time of initial discharge. Allow sufficient time between grout lifts to preclude displacement or cracking of face shells of masonry units. Provide a grout shear key between lifts when grouting is delayed and the lower lift loses plasticity. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, tear down the wall and rebuild.

3.4.2.2 Vertical Grout Barriers for Multi-Wythe Composite Walls

In multi-wythe composite walls, provide grout barriers in the collar joint not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.4.2.3 Horizontal Grout Barriers

Embed horizontal grout barriers in mortar below cells of hollow units receiving grout.

3.4.2.4 Grout Holes and Cleanouts

3.4.2.4.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of hollow unit masonry is indicated. Form such openings not less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.4.2.4.2 Cleanouts for Hollow Unit Masonry Construction

For hollow masonry units, provide cleanout holes at the bottom of every grout pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet 4 inches. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 32 inches where all cells are to be filled with grout.

Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Provide cleanouts not less than 3 by 3 inch by cutting openings in one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Do not cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.4.3 Cleanouts for Multi-Wythe Composite Masonry Construction

Provide cleanouts for construction of walls that incorporate a grout filled cavity between solid masonry wythes, provide cleanouts at the bottom of every pour by omitting every other masonry unit from one wythe. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Do not plug cleanout holes until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner to match surrounding masonry.

3.4.2.5 Grout Placement

A grout pour is the total height of masonry to be grouted prior to erection of additional masonry. A grout lift is an increment of grout placement within a grout pour. A grout pour is filled by one or more lifts of grout.

- a. Lay masonry to the top of a pour permitted by TMS MSJC Table 7, based on the size of the grout space and the type of grout. Prior to grouting, remove masonry protrusions that extend 1/2 inch or more into cells or spaces to be grouted. Provide grout holes and cleanouts in accordance with paragraph GROUT HOLES AND CLEANOUTS above when the grout pour height exceeds 5 feet 4 inches. Hold reinforcement, bolts, and embedded connections rigidly in position before grouting is started. Do not prewet concrete masonry units.
- b. Place grout using a hand bucket, concrete hopper, or grout pump to fill the grout space without segregation of aggregate. Operate grout pumps to produce a continuous stream of grout without air pockets, segregation, or contamination.
- c. If the masonry has cured at least 4 hours, grout slump is maintained between 10 to 11 inches, and no intermediate reinforced bond beams are placed between the top and bottom of the pour height, place conventional grout in lifts not exceeding 12 feet 8 inches. For the same curing and slump conditions but with intermediate bond beams, limit conventional grout lift to the bottom of the lowest bond beam that is more than 5 feet 4 inches above the bottom of the lift, but do not exceed 12 feet 8 inches. If masonry has not cured at least 4 hours or grout slump is not maintained between 10 to 11 inches, place conventional grout in lifts not exceeding 5 feet 4 inches.
- d. Consolidate conventional grout lift and reconsolidate after initial settlement before placing next lift. For grout pours that are 12 inches or less in height, consolidate and reconsolidate grout by mechanical vibration or puddling. For grout pours that are greater than 12 inches in height, consolidate and reconsolidate grout by mechanical vibration. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation. If previous lift is not permitted to set, dip vibrator into previous lift. Do not insert vibrators into lower lifts that are in a semi-solidified state. If lower lift sets prior to placement of subsequent lift, form a grout key by terminating grout a minimum of 1-1/2 inch below a mortar joint. Vibrate each vertical cell containing reinforcement in partially grouted masonry. Do not form grout keys within beams.

- e. If the masonry has cured 4 hours, place self-consolidating grout (SCG) in lifts not exceeding the pour height. If masonry has not cured for at least 4 hours, place SCG in lifts not exceeding 5 feet 4 inches. Do not mechanically consolidate self-consolidating grout. Place self-consolidating grout in accordance with manufacturer's recommendations.
- f. Upon completion of each day's grouting, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.4.3 Joint Reinforcement Installation

Install joint reinforcement at 16 inches on center unless otherwise indicated. Lap joint reinforcement not less than 6 inches. Install prefabricated sections at corners and wall intersections. Place the longitudinal wires of joint reinforcement in mortar beds to provide not less than 5/8 inch cover to either face of the unit.

3.4.4 Bond Beams

Reinforce and grout bond beams as indicated and as described in paragraphs above. Install grout barriers under bond beam units to retain the grout as required, unless wall is fully grouted or solid bottom units are used. For high lift grouting in partially grouted masonry, provide grout retaining material on the top of bond beams to prevent upward flow of grout. Ensure that reinforcement is continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated.

3.4.5 Flashing and Weeps

- a. Install through-wall flashing at obstructions in the cavity and where indicated on Drawings. Ensure continuity of the flashing at laps and inside and outside corners by splicing in a manner approved by the flashing manufacturer. Ensure that the top edge of the flashing is sealed by turning the flashing 1/2 inch into the mortar bed joint of backup masonry lapping a minimum of 6 inches under the weather resistive barrier. Terminate the horizontal leg of the flashing by extending the sheet metal 1/2 inch beyond the outside face of masonry and turning downward with a hemmed drip. Provide sealant below the drip edge of through-wall flashing.
- b. Wherever through-wall flashing occurs, provide weep holes to drain flashing to exterior at acceptable locations as indicated. Provide weeps of weep ventilators. Locate weeps not more than 24 inches on centers in mortar joints of the exterior wythe directly on the horizontal leg of through-wall flashing over foundations, bond beams, and any other horizontal interruptions of the cavity. Place weep holes perfectly horizontal or slightly canted downward to encourage water drainage outward and not inward. Other methods may be used for providing weeps when spacing is reduced to 16 inches on center and approved by the Contracting Officer. Maintain weeps free of mortar and other obstructions.
- c. Install single-wythe CMU flashing system in bed joints of CMU walls where CMU cells are open. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall on the exterior side. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs

and extend from face shell to face shell.

3.5 APPLICATION

3.5.1 Insulation

Insulate cavity walls (multi-wythe noncomposite masonry walls), where shown, by installing board-type insulation on the cavity side of the inner wythe. Apply board type insulation directly to the masonry or thru-wall flashing with adhesive. Neatly fit insulation between obstructions without impaling insulation on ties or anchors. Apply insulation in parallel courses with vertical joints breaking midway over the course below and in moderate contact with adjoining units without forcing. Cut to fit neatly against adjoining surfaces. Tape or seal the joints between the boards.

3.5.2 Interface with Other Products

3.5.2.1 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.

3.5.2.2 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.

3.5.2.3 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 as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5.3 Tolerances

Lay masonry plumb, true to line, with courses level within the tolerances of TMS MSJC, Article 3.3 F.

3.6 FIELD QUALITY CONTROL

3.6.1 Tests

3.6.1.1 Field Testing of Mortar

Perform mortar testing at the following frequency: prior to construction, each of the first days of construction, and per 5,000 SF of wall area per week (whichever occurs first). For each required mortar test, provide a minimum of three mortar samples.

Prepare and test mortar samples for mortar aggregate ratio in accordance with ASTM C780 Appendix A4. Prepare and test mortar compressive strength specimens in accordance with ASTM C780 Appendix A6.

3.6.1.2 Field Testing of Grout

- a. Perform grout testing at the following frequency: each 30 cubic yards of grout or fraction thereof placed each day and when mix proportions are changed. For each required grout property to be evaluated, provide a minimum of three specimens.
- b. Sample and test conventional and self-consolidating grout for compressive strength and temperature in accordance with ASTM C1019.
- c. Evaluate slump in conventional grout in accordance with ASTM C1019.
- d. Evaluate slump flow and visual stability index of self-consolidating grout in accordance with ASTM C1611/C1611M.

3.6.1.3 Prism Tests

Perform at least one prism test sample for each 5,000 square feet of wall but not less than three such tests for any building. Evaluate three prisms in each test. Fabricate, store, handle, and test prisms in accordance with ASTM C1314.

Seven-day tests may be used provided the relationship between the 7- and 28-day strengths of the masonry is established by the tests of the materials used. If the compressive strength of any prism falls below the specified value by more than 500 psi, take steps to assure that the load-carrying capacity of the structure is not jeopardized. If the likelihood of low-strength masonry is confirmed and computations indicate that the load-carrying capacity may have been significantly reduced, tests of cores drilled, or prisms sawed, from the area in question may be required. In such case, take three specimens for each prism test more than 500 psi below the specified value. Masonry in the area in question will be considered structurally adequate if the average compressive strength of three specimens is equal to or exceeds the specified value. Additional testing of specimens extracted from locations represented by erratic core or prism strength test results will be permitted.

3.6.2 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 --

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 12 00

STRUCTURAL STEEL

08/18, CHG 2: 05/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 AISC QUALITY CERTIFICATION
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Preconstruction Submittals
 - 1.4.1.1 Erection and Erection Bracing Drawings
 - 1.4.2 Fabrication Drawing Requirements
 - 1.4.3 Certifications
 - 1.4.3.1 Welding Procedures and Qualifications

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
- 2.2 STEEL
 - 2.2.1 Structural Steel
 - 2.2.2 Structural Steel Tubing
 - 2.2.3 Steel Pipe
- 2.3 BOLTS, NUTS, AND WASHERS
 - 2.3.1 Common Grade Bolts
 - 2.3.1.1 Bolts
 - 2.3.1.2 Nuts
 - 2.3.1.3 Washers
 - 2.3.2 High-Strength Bolts
 - 2.3.2.1 Bolts
 - 2.3.2.2 Nuts
 - 2.3.2.3 Direct Tension Indicator Washers
 - 2.3.2.4 Washers
 - 2.3.3 Tension Control Bolts
 - 2.3.4 Foundation Anchorage
 - 2.3.4.1 Anchor Rods
 - 2.3.4.2 Anchor Nuts
 - 2.3.4.3 Anchor Washers
 - 2.3.4.4 Anchor Plate Washers
- 2.4 STRUCTURAL STEEL ACCESSORIES
 - 2.4.1 Welding Electrodes and Rods
 - 2.4.2 Non-Shrink Grout
 - 2.4.3 Welded Shear Stud Connectors
- 2.5 GALVANIZING
- 2.6 FABRICATION
 - 2.6.1 Markings
 - 2.6.2 Shop Primer
 - 2.6.2.1 Cleaning
- 2.7 DRAINAGE HOLES

PART 3 EXECUTION

- 3.1 ERECTION
 - 3.1.1 STORAGE
- 3.2 CONNECTIONS
 - 3.2.1 Common Grade Bolts
 - 3.2.2 High-Strength Bolts
 - 3.2.2.1 Installation of Direct Tension Indicator Washers (DTIW)
 - 3.2.3 Tension Control Bolts
- 3.3 GAS CUTTING
- 3.4 WELDING
 - 3.4.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips
- 3.5 SHOP PRIMER REPAIR
 - 3.5.1 Field Priming
- 3.6 GALVANIZING REPAIR
- 3.7 FIELD QUALITY CONTROL
 - 3.7.1 Welds
 - 3.7.1.1 Visual Inspection
 - 3.7.1.2 Nondestructive Testing
 - 3.7.2 Direct Tension Indicator Washers
 - 3.7.2.1 Direct Tension Indicator Washer Compression
 - 3.7.2.2 Direct Tension Indicator Gaps
 - 3.7.3 High-Strength Bolts
 - 3.7.3.1 Testing Bolt, Nut, and Washer Assemblies
 - 3.7.3.2 Inspection
 - 3.7.3.3 Testing
 - 3.7.4 Inspection and Testing of Steel Stud Welding

-- End of Section Table of Contents --

SECTION 05 12 00

STRUCTURAL STEEL

08/18, CHG 2: 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 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

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) Structural Welding Code - Steel
AWS QC1	(2016) Specification for AWS Certification of Welding Inspectors

ASTM INTERNATIONAL (ASTM)

ASTM A6/A6M	(2017a) Standard Specification for General
-------------	--

	Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A29/A29M	(2020) Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought
ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A500/A500M	(2021) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	(2020) Standard Specification for Structural Steel Shapes
ASTM B695	(2004; R 2016) Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C827/C827M	(2016) Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
ASTM C1107/C1107M	(2020) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM F436/F436M	(2019) Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F844	(2019) Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F959/F959M	(2017a) Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series

ASTM F1136/F1136M	(2011) Standard Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F2329/F2329M	(2015) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
ASTM F2833	(2011; R 2017) Standard Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type
ASTM F3125/F3125M	(2019) Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2016) Shop, Field, and Maintenance Coating of Metals
SSPC Paint 20	(2019) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
SSPC Paint 29	(2002; E 2004) Zinc Dust Sacrificial Primer, Performance-Based
SSPC SP 3	(2018) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	(2019, 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 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

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

Tension Control Bolts

Recycled Content for Structural Steel; S

Recycled Content for Structural Steel Tubing; S

Recycled Content for Steel Pipe; S

SD-05 Design Data

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

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. Sign and seal fabrication drawings by a registered professional engineer. 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 Certifications

1.4.3.1 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welder or welding operator is more than 6 months old, the welding operator's qualification certificate must be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer and galvanizing, complete and ready for use. Provide structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing in accordance with AISC 303, AISC 360, and UFC 3-301-01 except as modified in this contract.

2.2 STEEL

2.2.1 Structural Steel

Wide flange and WT shapes, ASTM A992/A992M. Angles, Channels and Plates, ASTM A36/A36M. Provide structural steel containing a minimum of 80 percent recycled content. Submit data identifying percentage of recycled content for structural steel.

2.2.2 Structural Steel Tubing

ASTM A500/A500M, Grade C. Provide structural steel tubing containing a minimum of 25 percent recycled content. Submit data identifying percentage of recycled content for structural steel tubing.

2.2.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class STD (Standard) or as indicated. Provide steel pipe containing a minimum of 50 percent recycled content. Submit data identifying percentage of recycled content for steel pipe.

2.3 BOLTS, NUTS, AND WASHERS

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 Common Grade Bolts

2.3.1.1 Bolts

ASTM A307, Grade A, plain finish hot dipped zinc coating. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.3.1.2 Nuts

ASTM A563, Grade A, heavy hex style.

2.3.1.3 Washers

ASTM F844.

2.3.2 High-Strength Bolts

High strength bolts and nuts must be shipped together in the same shipping container. Fasteners indicated to be galvanized shall be tested by the

supplier to show that the galvanized nut with the supplied lubricant provided may be rotated from the snug tight condition well in excess of the rotation required for pretensioned installation without stripping. The supplier shall supply nuts that have been lubricated and tested with the supplied bolts.

2.3.2.1 Bolts

ASTM F3125/F3125M, A325 or A490, Type 1 Heavy Hex Head Style, plain finish hot dipped zinc coating or mechanically deposited zinc coating.

2.3.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.3.2.3 Direct Tension Indicator Washers

ASTM F959/F959M. Submit product data for direct tension indicator washers.

2.3.2.4 Washers

ASTM F436/F436M, plain carbon steel.

2.3.3 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 mechanically deposited zinc coating. Submit product data for tension control bolts.

2.3.4 Foundation Anchorage

2.3.4.1 Anchor Rods

ASTM F1554 Gr 36, Class 1A or as indicated on the design drawings.

2.3.4.2 Anchor Nuts

ASTM A563, Grade A, hex style.

2.3.4.3 Anchor Washers

ASTM F844.

2.3.4.4 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.

2.5 GALVANIZING

ASTM F2329/F2329M, ASTM F1136/F1136M, ASTM F2833 or ASTM B695 for threaded parts or ASTM A123/A123M for structural steel members, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

Fabrication must be in accordance with the applicable provisions of AISC 325. Fabrication and assembly must be done in the shop to the greatest extent possible. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member.

Compression joints depending on contact bearing must have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends must be square within the tolerances for milled ends specified in ASTM A6/A6M.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

2.6.1 Markings

Prior to erection, identify members by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections must be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

SSPC Paint 20 or SSPC Paint 29, (zinc rich primer). Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces designed as part of a composite steel concrete section, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking and shear studs are to be welded). If flash rusting occurs, re-clean the surface prior to application of primer. Apply primer 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.

2.7 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.

After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.1.1 STORAGE

Store the material out of contact with the ground in such manner and location as to minimize deterioration.

3.2 CONNECTIONS

Except as modified in this section, design connections indicated in accordance with AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Holes must not be cut or enlarged by burning. Bolts, nuts, and washers must be clean of dirt and rust, and lubricated immediately prior to installation.

3.2.1 Common Grade Bolts

Tighten ASTM A307 bolts to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.2.2 High-Strength Bolts

Provide direct tension indicator washers in all ASTM F3125/F3125M, Grade A325 and Grade A490 bolted connections. Bolts must be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, fully tension bolts, progressing from the most rigid part of a connection to the free edges.

Fastener components shall be protected from dirt and moisture in closed containers at the site of the installation. Fastener components that are not incorporated into the work shall be returned to protected storage at

the end of the work shift.

3.2.2.1 Installation of Direct Tension Indicator Washers (DTIW)

Where possible, install the DTIW under the bolt head and tighten the nut. If the DTIW is installed adjacent to the turned element, provide a flat washer between the DTIW and nut when the nut is turned for tightening, and between the DTIW and bolt head when the bolt head is turned for tightening. In addition to the DTIW, provide flat washers under both the bolt head and nut when ASTM F3125/F3125M, Grade A490 bolts are used.

3.2.3 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

Removal is not required.

3.5 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.5.1 Field Priming

Field prime steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat must be cleaned and primed with paint of the same quality as that used for the shop coat.

3.6 GALVANIZING REPAIR

Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.7 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. Notify the Contracting Officer in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of the inspection.

3.7.1 Welds

3.7.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. A Certified Welding Inspector must perform visual inspection on 100 percent of all welds. Document this inspection in the Visual Weld Inspection Log. Submit certificates indicating that certified welding inspectors meet the requirements of AWS QC1.

3.7.1.2 Nondestructive Testing

Nondestructive testing must be in accordance with AWS D1.1/D1.1M. Ultrasonic testing must be performed in accordance with Table 6.2 or 6.3 of AWS D1.1/D1.1M. Test locations must be selected by 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:

<u>Test Type</u>	<u>Number of Tests</u>
Ultrasonic	50 percent of CJP Welds
Magnetic Particle	50 percent of PJP and Fillet Welds
Dye Penetrant	50 percent of PJP and Fillet Welds

3.7.2 Direct Tension Indicator Washers

3.7.2.1 Direct Tension Indicator Washer Compression

Test direct tension indicator washers in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap, as required by ASTM F959/F959M. Submit direct tension indicator washer inspection reports.

3.7.2.2 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.

3.7.3 High-Strength Bolts

3.7.3.1 Testing Bolt, Nut, and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC 360, depending on bolt size and grade. The bolt tension must be developed by tightening the nut. A representative of the manufacturer or supplier must be present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements. Submit bolt testing reports.

3.7.3.2 Inspection

Inspection procedures must be in accordance with AISC 360. Confirm and report to the Contracting Officer that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

Inspect calibration of torque wrenches for high-strength bolts.

3.7.3.3 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. Provide the required access for the Government to perform the tests. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations must be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, must be tested at the Contractor's expense. Retest new bolts after installation at the Contractor's expense.

3.7.4 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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 30 00

STEEL DECKS

05/15, CHG 2: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY ASSURANCE
 - 1.3.1 Deck Units
 - 1.3.2 Qualifications for Welding Work
 - 1.3.3 Regulatory Requirements
 - 1.3.3.1 Fire Safety
 - 1.3.3.2 Wind Storm Resistance
 - 1.3.4 Fabrication Drawings
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 DESIGN REQUIREMENTS FOR ROOF DECKS
 - 1.5.1 Properties of Sections
 - 1.5.2 Allowable Loads

PART 2 PRODUCTS

- 2.1 DECK UNITS
 - 2.1.1 Roof Deck
 - 2.1.2 Composite Deck
 - 2.1.3 Form Deck
 - 2.1.4 Length of Deck Units
 - 2.1.5 Touch-Up Paint
- 2.2 ACCESSORIES
 - 2.2.1 Adjusting Plates
 - 2.2.2 End Closures
 - 2.2.3 Partition Closures
 - 2.2.4 Flexible Closure Strips for Roof Decks
 - 2.2.5 Closure Plates for Composite Deck
 - 2.2.6 Sheet Metal Collar
 - 2.2.7 Cover Plates
 - 2.2.8 Column Closures
 - 2.2.9 Access Hole Covers
 - 2.2.10 Hanger
 - 2.2.11 Shear Connectors
 - 2.2.12 Cant Strips for Roof Decks
 - 2.2.13 Ridge and Valley Plates for Roof Decks
 - 2.2.14 Metal Closure Strips for Roof Decks
 - 2.2.15 Galvanized Steel Angles for Roof Decks
 - 2.2.16 Miscellaneous Accessories

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION

- 3.2.1 Attachment
 - 3.2.1.1 Welding
 - 3.2.1.2 Sidelap Fastening
- 3.2.2 Openings
- 3.2.3 Deck Damage
- 3.2.4 Touch-Up Paint
 - 3.2.4.1 Roof Deck
 - 3.2.4.2 Floor Deck
- 3.2.5 Accessory Installation
 - 3.2.5.1 Adjusting Plates
 - 3.2.5.2 End Closures
 - 3.2.5.3 Closures Above Partitions
 - 3.2.5.4 Cover Plates
 - 3.2.5.5 Column Closures
 - 3.2.5.6 Access Hole Covers
 - 3.2.5.7 Hangers
- 3.2.6 Concrete Work
- 3.2.7 Preparation of Fire-Proofed Surfaces
- 3.3 CANT STRIPS FOR ROOF DECKS
- 3.4 RIDGE AND VALLEY PLATES FOR ROOF DECKS
- 3.5 CLOSURE STRIPS FOR ROOF DECKS
- 3.6 ROOF INSULATION SUPPORT FOR ROOF DECKS
- 3.7 CLEANING AND PROTECTION FOR ROOF DECKS
- 3.8 FIELD QUALITY CONTROL
 - 3.8.1 Headed Stud Inspection
 - 3.8.2 Deck Weld Inspection
 - 3.8.3 Decks Not Receiving Concrete

-- End of Section Table of Contents --

SECTION 05 30 00

STEEL DECKS

05/15, CHG 2: 08/18

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI D100 (2017) Cold-Formed Steel Design Manual

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020) 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 (2020) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable

ASTM D746 (2014) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact

ASTM D1056 (2014) Standard Specification for Flexible

	Cellular Materials - Sponge or Expanded Rubber
ASTM D1149	(2007; R 2012) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
FM GLOBAL (FM)	
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/
FM DS 1-28R	(1998) Data Sheet: Roof Systems
SOCIETY FOR PROTECTIVE COATINGS (SSPC)	
SSPC Paint 20	(2019) Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)
STEEL DECK INSTITUTE (SDI)	
ANSI/SDI C	(2017) Standard for Composite Steel Floor Deck - Slabs
ANSI/SDI NC	(2017) Standard for Non-Composite Steel Floor Deck
ANSI/SDI QA/QC	(2017) Standard for Quality Control and Quality Assurance for Installation of Steel Deck
ANSI/SDI RD	(2017) Standard for Steel Roof Deck
SDI DDM04	(2015; Errata 1-3 2016; Add 1 2015; Add 2 20162006) Diaphragm Design Manual; 4th Edition
SDI DDP	(1987; R 2000) Deck Damage and Penetrations
SDI MOC3	(2016) Manual of Construction with Steel Deck (3rd Edition)
U.S. DEPARTMENT OF DEFENSE (DOD)	
UFC 3-301-01	(2019, 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 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

Fabrication Drawings; G, AE

SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Touch-Up Paint

Welding Equipment

Welding Rods and Accessories

Recycled Content of Steel Deck; S

SD-04 Samples

Metal Roof Deck Units

Flexible Closure Strips

SD-05 Design Data

Deck Units; G, AE

SD-07 Certificates

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 Qualifications for Welding Work

Follow Welding Procedures of AWS D1.3/D1.3M for sheet steel and AWS D1.1/D1.1M for stud welding. Submit qualified Welder Qualifications in accordance with AWS D1.3/D1.3M for sheet steel and AWS D1.1/D1.1M for stud welding, or under an equivalent approved qualification test. Perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, perform an immediate retest of two test welds until each test weld passes. Failure in the immediate retest will require the welder be retested after further practice or training, performing a complete set of test welds.

Submit manufacturer's catalog data for Welding Equipment and Welding Rods and Accessories.

1.3.3 Regulatory Requirements

1.3.3.1 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.

1.3.3.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding a nominal uplift pressure as calculated per FM Global Property Loss Prevention Data Sheets, 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.

1.3.4 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 steel deck containing a minimum of 50 percent recycled content. Submit data identifying percentage of recycled content of steel deck.

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 galvanized or 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.

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 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 zinc-coated units of an approved galvanizing repair paint with a high-zinc dust content. Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A780/A780M. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.0295 inch thick to close open ends at exposed edges of floors, parapets, end walls, eaves, and openings through deck.

2.2.3 Partition Closures

Provide closures for closing voids above interior walls and partitions that are perpendicular to the direction of the configurations. Provide rubber, plastic, or sheet steel closures above typical partitions. Provide sheet steel closures above fire-resistant interior walls and partitions located on both sides of wall or partition. Provide glass fiber blanket insulation in the space between pairs of closures at acoustical partitions.

2.2.4 Flexible Closure Strips for Roof Decks

Provide strips made of vulcanized, closed-cell, synthetic rubber material specified and premolded to the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

Conforming to ASTM D1056, Grade 2A1, with the following additional properties:

Brittleness temperature of minus 40 degrees F when tested in accordance with ASTM D746.

Flammability resistance with a flame spread rating of less than 25 when tested in accordance with ASTM E84.

Resistance to ozone must be "no cracks" after exposure of a sample kept under a surface tensile strain of 25 percent to an ozone concentration of 100 parts per million of air by volume in air for 100 hours at 104 degrees F and tested in accordance with ASTM D1149.

Provide a elastomeric type adhesive as recommended by the manufacturer of the flexible closure strips.

2.2.5 Closure Plates for Composite Deck

Support and retain concrete at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Provide metal closures for all openings in composite steel deck 1/4 inch and over.

2.2.6 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.7 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

Fabricate cover plates for abutting floor deck units from the specified structural-quality steel sheets not less than nominal 18 gage thick before galvanizing. Provide 6 inch wide cover plates and form to match the contour of the floor deck units.

2.2.8 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.9 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

2.2.10 Hanger

Provide clips or loops for utility systems and suspended ceilings of one or more of the following types:

- a. Lip tabs or integral tabs where noncellular decking or flat plate of cellular section is 0.0474 inch thick or more, and a structural concrete fill is used over deck.
- b. Slots or holes punched in decking for installation of pigtails.
- c. Tabs driven from top side of decking and arranged so as not to pierce electrical cells.
- d. Decking manufacturer's standard as approved by the Contracting Officer.

2.2.11 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.

2.2.12 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.

2.2.13 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.

2.2.14 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.

2.2.15 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.

2.2.16 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 and SDI DDM04 and approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the

Contracting Officer and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Lap 2 inch deck ends. Do not use unanchored deck units as a work or storage platform. Do not fill unanchored deck with concrete. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal 5/8 inch diameter puddle welds, 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. Anchoring the deck to structural supports with powder-actuated fasteners or pneumatically driven fasteners is prohibited. 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. Indicate for location, size, and spacing of fastening. Do use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDM04. Attach shear connectors as shown and welded as per AWS D1.1/D1.1M through the steel deck to the steel member or directly to the steel member. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A780/A780M.

3.2.1.2 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.

3.2.3 Deck Damage

SDI MOC3, for repair of deck damage.

3.2.4 Touch-Up Paint

3.2.4.1 Roof Deck

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint. Touchup painted surfaces with repair paint of painted surfaces.

3.2.4.2 Floor Deck

For floor decking installation, wire brush, clean, and touchup paint the scarred areas on the top and bottom surfaces of the metal floor decking and on the surface of supporting steel members. Include welds, weld scars, bruises, and rust spots for scarred areas. Touched up the galvanized surfaces with galvanizing repair paint. Touch up the painted surfaces with paint for the repair of painted surfaces.

3.2.5 Accessory Installation

3.2.5.1 Adjusting Plates

Provide in locations too narrow to accommodate full-size deck units and install as shown on shop drawings.

3.2.5.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.2.5.3 Closures Above Partitions

Provide for closing voids between cells over partitions that are perpendicular to direction of cells. Provide a one-piece closure strip for partitions 4 inch nominal or less in thickness and two-piece closure strips for wider partitions. Provide sheet metal closures above fire-rated partitions at both sides of partition with space between filled with fiberglass insulation. Provide flexible rubber closures above acoustic-rated partitions at both sides of partition with space between filled with blanket insulation.

3.2.5.4 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

Provide as indicated to support utility system and suspended ceilings. Space devices as indicated so as to provide one device per 6.25 square feet.

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 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 12 inch. Lap end joints a minimum 3 inch and secure with galvanized sheet metal screws spaced a maximum 4 inch on center.

3.4 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3 inch. For valley plates, provide endlaps to be in the direction of water flow.

3.5 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

3.6 ROOF INSULATION SUPPORT FOR ROOF DECKS

Provide metal closure strips for support of roof insulation where rib openings in top surface of metal roof decking occur adjacent to edges and openings. Weld metal closure strips in position.

3.7 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.8 FIELD QUALITY CONTROL

3.8.1 Headed Stud Inspection

In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

- a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
- b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.8.2 Deck Weld Inspection

Visual inspect welds in accordance with AWS D1.3/D1.3M.

3.8.3 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges should not exceed manufacturing and construction tolerances of supporting members. When gap is more than the allowable, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 40 00

COLD-FORMED METAL FRAMING

05/15, CHG 1: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING
- 1.4 LOAD-BEARING COLD-FORMED METAL FRAMING
- 1.5 MAXIMUM DEFLECTION
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Drawing Requirements
 - 1.6.2 Design Data Required

PART 2 PRODUCTS

- 2.1 STEEL STUDS, JOISTS, TRACKS, BRACING, BRIDGING AND ACCESSORIES
 - 2.1.1 Studs and Joists of 54 mils (0.054 Inch) and Heavier
 - 2.1.2 Studs and Joists of 43 mils (0.043 Inch) and Lighter
 - 2.1.3 Sizes, Thickness, Section Modulus, and Other Structural Properties
- 2.2 MARKINGS
- 2.3 CONNECTIONS
 - 2.3.1 Steel-To-Concrete Connections
 - 2.3.2 Steel-To-Steel Connections
- 2.4 PLASTIC GROMMETS
- 2.5 SEALER GASKET

PART 3 EXECUTION

- 3.1 FASTENING
 - 3.1.1 Welds
 - 3.1.2 Screws
 - 3.1.3 Anchors
- 3.2 INSTALLATION
 - 3.2.1 Tracks
 - 3.2.2 Studs
 - 3.2.3 Erection Tolerances

-- End of Section Table of Contents --

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 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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020) Structural Welding Code - Steel

AWS D1.3/D1.3M (2018) Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc

	Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A370	(2020) Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A1003/A1003M	(2015) Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members
ASTM C955	(2017) Standard Specification for Cold-Formed Steel Structural Framing Members
ASTM C1007	(2020) Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
ASTM C1513	(2018) Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM E119	(2020) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E329	(2021) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F1941	(2010) Standard Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))
ASTM F2329/F2329M	(2015) Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01 (2019, 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 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

Framing Components; G, AE

SD-03 Product Data

Steel Studs, Joists, Tracks, Bracing, Bridging and Accessories

Recycled Content of Metal Framing; S

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.

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, or in-house testing with calibrated test equipment 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 S200, "North American Standard for Cold-Formed Steel Framing - General Provision".
 - (3) AISI S201, "North American Standard for Cold-Formed Steel Framing - Product Data".
 - (4) AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing".
 - (5) AISI S211, "North American Standard for Cold-Formed Steel Framing - Wall Stud Design".
 - (6) AISI S212, "North American Standard for Cold-Formed Steel Framing - Header 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 cold formed metal framing containing a minimum of 25 percent post-consumer recycled content. Submit data identifying percentage of recycled content of metal framing.
- b. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - (1) Grade: As required by structural performance.
 - (2) Coating: G90 (Z275).
- c. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - (1) Minimum Base-Metal Thickness: As required by structural performance.
 - (2) Flange Width: As required by structural performance.
- d. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
 - (1) Minimum Base-Metal Thickness: Matching steel studs or as required by structural performance.
 - (2) Flange Width: As required by structural performance.

2.1.1 Studs and Joists of 54 mils (0.054 Inch) and Heavier

Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS Grade 50, G90.

2.1.2 Studs and Joists of 43 mils (0.043 Inch) and Lighter

Studs and Joists of 43 mils (0.043 Inch) and Lighter, Track, and Accessories (All thicknesses): Galvanized steel, ASTM A653/A653M and ASTM A1003/A1003M, SS, Grade 33 33,000 psi G60.

2.1.3 Sizes, Thickness, Section Modulus, and Other Structural Properties

Size and thickness as required.

2.2 MARKINGS

Studs and track shall have product markings stamped on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 4 feet on center and shall be legible and easily read. The product marking shall include the following:

- a. An ICC number.
- b. Manufacturer's identification.
- c. Minimum delivered uncoated steel thickness.
- d. Protective coating designator.
- e. Minimum yield strength.

2.3 CONNECTIONS

2.3.1 Steel-To-Concrete Connections

- a. Anchor Rods: ASTM F1554, Grade 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:

<u>LOAD</u>	<u>HEIGHT</u>	<u>BRACING</u>
Wind load only	Up to 10 feet	One row at mid-height
	Over 10 feet	Rows 5'-0" o.c. maximum
Axial load	Up to 10 feet	Two rows at 1/3 points
	Over 10 feet	Rows 3'-4" o.c. maximum

3.2.3 Erection Tolerances

- a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within the following limits:
 - (1) Layout of walls and partitions: 1/4 inch from intended position;
 - (2) Plates and runners: 1/4 inch in 8 feet from a straight line;
 - (3) Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
 - (4) Face of framing members: 1/4 inch in 8 feet from a true plane.
- b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:
 - (1) Layout of walls and partitions: 1/4 inch from intended position;
 - (2) Plates and runners: 1/8 inch in 8 feet from a straight line;

(3) Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

(4) Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

05/17, CHG 1: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALIFICATION OF WELDERS
- 1.4 DELIVERY, STORAGE, AND PROTECTION
- 1.5 MISCELLANEOUS REQUIREMENTS
 - 1.5.1 Fabrication Drawings
 - 1.5.2 Installation Drawings

PART 2 PRODUCTS

- 2.1 RECYCLED CONTENT
- 2.2 MATERIALS
 - 2.2.1 Structural Carbon Steel
 - 2.2.2 Structural Tubing
 - 2.2.3 Steel Pipe
 - 2.2.4 Fittings for Steel Pipe
 - 2.2.5 Gratings
 - 2.2.6 Anchor Bolts
 - 2.2.6.1 Expansion Anchors and Adhesive Anchors
 - 2.2.6.2 Lag Screws and Bolts
 - 2.2.6.3 Toggle Bolts
 - 2.2.6.4 Bolts, Nuts, Studs and Rivets
 - 2.2.6.5 Powder Actuated Fasteners
 - 2.2.6.6 Screws
 - 2.2.6.7 Washers
 - 2.2.6.8 Welded Headed Shear Studs
 - 2.2.7 Aluminum Alloy Products
- 2.3 FABRICATION FINISHES
 - 2.3.1 Galvanizing
 - 2.3.2 Galvanize
 - 2.3.3 Repair of Zinc-Coated Surfaces
 - 2.3.4 Shop Cleaning and Painting
 - 2.3.4.1 Surface Preparation
 - 2.3.4.2 Pretreatment, Priming and Painting
 - 2.3.5 Nonferrous Metal Surfaces
 - 2.3.6 Aluminum Surfaces
 - 2.3.6.1 Surface Condition
 - 2.3.6.2 Aluminum Finishes
- 2.4 FLOOR GRATINGS
- 2.5 BOLLARDS
- 2.6 DOWNSPOUT TERMINATIONS
- 2.7 MISCELLANEOUS PLATES AND SHAPES
- 2.8 ROOF HATCHES (SCUTTLES)
- 2.9 METAL CANOPIES

- 2.9.1 Materials
- 2.9.2 Components
 - 2.9.2.1 Canopy Main Frame
 - 2.9.2.2 Decking
 - 2.9.2.3 Perimeter Fascia
 - 2.9.2.4 Flashing
 - 2.9.2.5 Fasteners
 - 2.9.2.6 Down Spouts
- 2.9.3 Fabrication
- 2.9.4 Finishes

PART 3 EXECUTION

- 3.1 GENERAL INSTALLATION REQUIREMENTS
- 3.2 WORKMANSHIP
- 3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS
- 3.4 BUILT-IN WORK
- 3.5 WELDING
- 3.6 DISSIMILAR METALS
- 3.7 PREPARATION
 - 3.7.1 Material Coatings and Surfaces
 - 3.7.2 Environmental Conditions
- 3.8 ROOF HATCH (SCUTTLES)
- 3.9 INSTALLATION OF BOLLARDS
- 3.10 INSTALLATION OF DOWNSPOUT TERMINATIONS
- 3.11 INSTALLATION MISCELLANEOUS PLATES AND SHAPES

-- 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 ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605 (2020) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

AMERICAN 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 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, 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) 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 A108 (2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A123/A123M (2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A307 (2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM A500/A500M (2021) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A780/A780M (2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings

ASTM A924/A924M (2020) Standard Specification for General Requirements for Steel Sheet,

Metallic-Coated by the Hot-Dip Process

ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM 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 B429/B429M	(2010; E 2012) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
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 E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F1554	(2020) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	(2016) Primer, Alkyd, Anti-Corrosive for Metal
--------	--

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(2017) Metal Bar Grating Manual
---------------	---------------------------------

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 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 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

Floor Gratings, Installation Drawings; G

Bollards; G

Embedded Angles and Plates, Installation Drawings; G

Roof Hatches, Installation Drawings; G

Metal Canopies

SD-03 Product Data

Metal Canopies

Floor Gratings; G

Roof Hatches; G

Each Downspout Terminations Type; G

Recycled Content; S

SD-04 Samples

Color samples for Metal Canopies; G

SD-07 Certificates

Certificates of Compliance; G

Certified Mill Test Reports for Chemistry and Mechanical Properties; G

Design Data For Metal Canopies, Provide Professional Engineering Certification That The Proposed Canopy Design And Layout Meets Or Exceeds All Applicable Structural Loading Criteria

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. Provide certificates of compliance for recycled content.

2.2 MATERIALS

Provide exposed fastenings of compatible materials (avoid contact of dissimilar metals). Coordinate color and finish with the material to which fastenings are applied. Submit the manufacturer's certified mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied materials.

2.2.1 Structural Carbon Steel

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 Gratings

c. Provide metal bar type grating in accordance with NAAMM MBG 531.

2.2.6 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.

2.2.6.1 Expansion Anchors and Adhesive Anchors

Provide 1/2in. diameter expansion anchors and adhesive anchors. Minimum concrete or masonry embedment of 2in. Design values listed are as tested in accordance with ASTM E488/E488M.

- a. Provide minimum allowable pullout value of 500lb. Calculate pullout capacity according to ACI 318.
- b. Provide minimum allowable shear value of 1000lb. Calculate shear capacity according to ACI 318.

2.2.6.2 Lag Screws and Bolts

Provide in accordance with ASME B18.2.1, type and grade best suited for the purpose.

2.2.6.3 Toggle Bolts

Provide in accordance with ASME B18.2.1.

2.2.6.4 Bolts, Nuts, Studs and Rivets

Provide in accordance with ASME B18.2.2 or ASTM A307.

2.2.6.5 Powder Actuated Fasteners

Follow safety provisions in accordance with ASSP A10.3.

2.2.6.6 Screws

Provide in accordance with ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C1513.

2.2.6.7 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.

2.2.6.8 Welded Headed Shear Studs

Provide in accordance with ASTM A108.

2.2.7 Aluminum Alloy Products

Provide in accordance with ASTM B209M, ASTM B209 for sheet plate, ASTM B221M, ASTM B221M, ASTM B221 for extrusions and ASTM B26/B26M or ASTM B108/B108M for castings. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.3 FABRICATION FINISHES

2.3.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Provide galvanizing in accordance with ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, Z275 G90.

2.3.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.3.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint in accordance with ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat, with a torch, surfaces to which stick or paste material will be applied. Heat to a temperature sufficient to melt the metals in the stick or paste. Spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.3.4 Shop Cleaning and Painting

2.3.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete must be free of dirt and grease prior to embed. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints. Shop coat these surfaces with rust prevention.

2.3.4.2 Pretreatment, Priming and Painting

Apply pre-treatment, 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.

2.3.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.3.6 Aluminum Surfaces

2.3.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.3.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, 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 FLOOR GRATINGS

Design steel grating in accordance with NAAMM MBG 531 for bar type gratings, or in accordance with manufacturer's charts for plank grating. Galvanize steel floor gratings.

- a. Design floor gratings to support a stress live load of 100 pounds per square foot for the spans indicated, with maximum deflection of $L/240$.
- b. In accordance with NAAMM MBG 531, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and to match grating finish.
- c. Anchor gratings to structural members with bolts, toggle bolts, or expansion shields and bolts.
- d. Provide slip resistant surface finishes.

2.5 BOLLARDS

Provide 6 inch galvanized standard weight steel pipe in accordance with ASTM A53/A53M. Anchor posts in concrete and fill solidly with concrete with minimum compressive strength of 2500 psi.

2.6 DOWNSPOUT TERMINATIONS

Provide 5x4 inch galvanized cast iron downspout boot with cleanout access and manufacturer's standard cast iron strap.

2.7 MISCELLANEOUS PLATES AND SHAPES

Provide items that do not form a part of the structural steel framework, such as lintels, sill angles, support framing for ceiling-mounted toilet partitions, 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 fasteners. 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 ROOF HATCHES (SCUTTLES)

Provide aluminum or zinc-coated steel sheets not less than 14 gauge with 3 inch beaded flange, welded and ground at corners. Provide a minimum clear opening of 30 by 37 inches. Insulate cover and curb with one inch thick rigid fiberboard insulation, covered and protected by aluminum sheet or zinc-coated steel liner of not less than 26 gage. Provide with 12 inches high curb, formed with 3 inch mounting flanges with holes for securing to the roof deck. Provide roof hatch with safety railing as indicated and in accordance with 05 52 00 METAIL RAILING.

2.9 METAL CANOPIES

Obtain all metal canopies, attachments, drainage devices, and other accessories from single source manufacturer.

Delegated Design: Engage a professional engineer to design metal canopy to withstand loading criteria as indicated for project location.

- a. Aluminum protective cover shall be welded together into a frame system consisting of the main support frame and the decking frame. Mechanically fastened connections can be used if shipping does not allow welded system.
- b. Canopy shall use perimeter "J" channel as fascia and the decking shall run perpendicular to the plane of the wall. All beams shall have welded caps at the ends to prevent any water leakage.
- c. Canopies shall drain from the decking to the drain beam against the wall, down the vertical downspout, and discharge at the bottom of the downspout at grade. Downspout shall be designed to discharge the water away from the entrance.
- d. The canopy frame is to be fastened to the wall using required fasteners to withstand loading criteria as indicated.
- e. Custom flashing is to be used under the decking frame to prevent water from blowing out between the decking and drain beam.

2.9.1 Materials

Aluminum Extrusions:

- a. ASTM B221 and ASTM B429/B429M 6063-T5 alloy and temper.

Hardware:

- a. All fasteners shall be stainless steel.

2.9.2 Components

2.9.2.1 Canopy Main Frame

Main frame is to be made using manufacturer's standard extruded aluminum sections and aluminum drain beams (minimum 4"x8"x0.125", unless larger are required due to canopy spans). The only drain beam is located at the back of the frame against the wall to receive all draining water from the canopy top.

- a. Provide manufacturer's standard steel hangar tubes welded to steel backing plate and thru bolts for cantilevered canopy application. Separate dissimilar metals to prevent galvanic action. Provide finish to match canopy fascia and decking.

The main frame is to be welded into a solid frame prior to installation. If welding the main frame into one single frame is not possible due to size constraints, the support frame can be made up of multiple smaller frames.

The main frame shall be fabricated and welded to create a minimum 1:12 pitch of the canopy toward the receiving beam against the wall.

2.9.2.2 Decking

Manufacturer's standard interlocking, extruded aluminum flat soffit decking: 3" x 6" x 0.090", unless larger are required due to canopy spans. Interlocking decking shall provide watertight seal.

2.9.2.3 Perimeter Fascia

Perimeter fascia shall be manufacturer's standard "J" channel fascia: 8" x 0.125", unless larger are required due to canopy spans.

2.9.2.4 Flashing

Flashing shall be made of stainless steel sheet painted to match the color of the canopy. Minimum flashing thickness shall be 0.0156" thick.

2.9.2.5 Fasteners

All framing fasteners shall be 300 series stainless steel with neoprene washers. All rivets are 3/16" aluminum. All decking fasteners shall be long life coated steel with a 300 series stainless steel cap and neoprene washer. Large bell washer shall be used with all decking fasteners.

2.9.2.6 Down Spouts

Extruded aluminum downspout: Minimum 2" x 3" x 0.125"

2.9.3 Fabrication

Fabricate canopy system in accordance with approved Shop Drawings. Kit canopies to be mechanically assembled with shear stress strength as per engineering. Pre-assembled canopies are shop welded by approved personnel.

Drainage system to be concealed type. Covered surfaces direct water to field drilled drain, to be coordinated at site.

2.9.4 Finishes

Aluminum:

- a. Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color: As selected by COR from manufacturers full range of Fluoropolymer finishes.

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 countersunk 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 ROOF HATCH (SCUTTLES)

Construction and accessories as follows:

- a. Provide insulated cover and curb with mounting flanges for securing to roof deck. Provide curbs with integral metal cap flashing of the same gage and metal as the curb, fully welded and ground at corners for weather tightness.
- b. Provide hatches completely assembled, with pintle hinges, compression spring operators enclosed in telescopic tubes, positive snap latches with turn handles on inside and outside, and neoprene draft seals. Provide fasteners for padlocking from the inside. Provide covers with automatic hold-open arms complete with grip handle to permit one hand release. Cover action must be smooth through its entire range of motion with an operating pressure of approximately 30 pounds.

3.9 INSTALLATION OF BOLLARDS

Set bollards vertically in concrete piers. Fill hollow cores with concrete having a compressive strength of 3000 psi.

3.10 INSTALLATION OF DOWNSPOUT TERMINATIONS

Secure downspouts terminations to downspouts and substrate per manufacturer's instructions.

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 fasteners. Construct to have at least 8 inches bearing on masonry at each end.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 51 00

METAL STAIRS

02/17, CHG 1: 05/17

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY CONTROL
 - 1.3.1 Qualifications for Welding Work
 - 1.3.2 Shop Drawings
 - 1.3.3 Design Calculations
 - 1.3.3.1 Certification Letter from Contractor's Professional Engineer

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
- 2.2 FABRICATION
 - 2.2.1 General Fabrication
 - 2.2.2 Steel Pan Stairs
 - 2.2.2.1 General
 - 2.2.2.2 Stair Framing
 - 2.2.2.3 Riser, Subtread, and Subplatform Metal Pans
 - 2.2.2.4 Metal Safety Nosings
 - 2.2.2.5 Safety Nosings for Concrete Treads
 - 2.2.2.6 Safety Treads
 - 2.2.2.7 Steel Framing for Concrete Stairs
 - 2.2.3 Protective Coating
- 2.3 COMPONENTS
 - 2.3.1 Steel Stairs
 - 2.3.1.1 Design Loads
 - 2.3.1.2 Materials
 - 2.3.2 Soffit Clips
 - 2.3.3 Concrete Inserts
 - 2.3.4 Masonry Anchorage Devices
 - 2.3.5 Fasteners
- 2.4 MATERIALS
 - 2.4.1 Structural Steel Plates, Shapes and Bars
 - 2.4.2 Structural Steel Tubing
 - 2.4.3 Hot-Rolled Carbon Steel Bars
 - 2.4.4 Cold-Finished Steel Bars
 - 2.4.5 Hot-Rolled Carbon Steel Sheets and Strips
 - 2.4.6 Cold-Rolled Carbon Steel Sheets
 - 2.4.7 Galvanized Carbon Steel Sheets
 - 2.4.8 Cold-Drawn Steel Tubing
 - 2.4.9 Steel Pipe

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 INSTALLATION
 - 3.2.1 Field Preparation
 - 3.2.2 Field Welding
 - 3.2.3 Safety Nosings
 - 3.2.4 Touchup Painting

-- End of Section Table of Contents --

SECTION 05 51 00

METAL STAIRS

02/17, CHG 1: 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 M 314 (1990; R 2013) Standard Specification for
Steel Anchor Bolts

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 360 (2016) Specification for Structural Steel
Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121 (2007) Standard Definitions for Use in the
Design of Steel Structures

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1 (2012; Errata 2013) Square and Hex Bolts
and Screws (Inch Series)

ASME B18.6.1 (2016) Wood Screws (Inch Series)

ASME B18.6.3 (2013; R 2017) Machine Screws, Tapping
Screws, and Machine Drive Screws (Inch
Series)

ASME B18.21.1 (2009; R 2016) Washers: Helical
Spring-Lock, Tooth Lock, and Plain Washers
(Inch Series)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020) 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 A325	(2014) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A449	(2014; R 2020) Standard Specification for Hex Cap Screws, Bolts, and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A500/A500M	(2021) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A512	(2006; R 2012) Standard Specification for Cold-Drawn Buttweld Carbon Steel Mechanical Tubing
ASTM A568/A568M	(2019a) Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A575	(2020) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet,

Metallic-Coated by the Hot-Dip Process

ASTM A1008/A1008M	(2020) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
ASTM A1011/A1011M	(2018a) Standard Specification for Steel Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
ASTM C514	(2004; R 2020) Standard Specification for Nails for the Application of Gypsum Board
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements

NATIONAL 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 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

Iron and Steel Hardware; G
 Steel Shapes, Plates, Bars, and Strips; G
 Metal Stair System Fabrication Drawing; G, AE

SD-03 Product Data

Structural Steel Plates, Shapes, and Bars; G
 Structural Steel Tubing; G
 Hot-Rolled Carbon Steel Sheets and Strips; G
 Cold-Finished Steel Bars; G

Hot-Rolled Carbon Steel Bars; G

Cold-Rolled Carbon Steel Sheets; G

Galvanized Carbon Steel Sheets; G

Cold-Drawn Steel Tubing; G

Concrete Inserts; G

Masonry Anchorage Devices; G

Protective Coating; G

Steel Pan Stairs; G, AE

Steel Stairs; G, AE

Recycled Content for Steel; S

SD-07 Certificates

Welding Procedures; G

Welder Qualification; G

Certification Letter from Contractor's Professional Engineer; G

SD-08 Manufacturer's Instructions

Structural Steel Plates, Shapes, and Bars; G

Structural Steel Tubing; G

Galvanized Carbon Steel Sheets; G

Protective Coating; G

Masonry Anchorage Devices; G

Masonry Anchorage Devices; G

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.

1.3.2 Shop Drawings

Include plans, elevations, sections, details, and attachments to otherwork. Indicate sizes, spacing and locations of structural members. Include details of cuts, connections, splices, attachments, holes, and other pertinent data. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Indicate all AWS weld designations for pre-qualified full and partial penetration welds and detail all joint preparations. Provide erection details of all field welded connections. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Detail material required for the connection of other work. The Professional Structural Engineer's signature and seal shall appear on all structural steel shop drawings (including erection drawings, piece drawings and connection calculations. Cloud, bubble, or otherwise highlight and identify all revisions on the drawings. Submittals which do not identify changes and revisions will be returned as "Not Reviewed". Drawings that have been renumbered will be rejected.

1.3.3 Design Calculations

Design Calculations for Metal Stairs: Design Metal stairs under direct supervision of the manufacturer employed Professional Engineer. Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers and a coordinated table of contents. Design Calculations submittal shall be signed and sealed by a qualified Professional Engineer licensed in the state or district in which the project is located. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect. Design Calculations submission must be concurrent with the submission of corresponding Fabrication drawings. Fabrication drawings submitted without corresponding Design Calculations will be returned as "Not Reviewed". Design Calculations shall be submitted for information only.

1.3.3.1 Certification Letter from Contractor's Professional Engineer

Prior to the submission of Shop Drawings, Product Data, Design Calculations and other required submittals, submit a Certification Letter from the Contractor's responsible design Professional Engineer. No shop drawings will be reviewed by the Architect prior to the submission and acceptance of this Certification Letter. Certification Letter shall be submitted for information only. The Certification Letter shall include the following:

- a. Signature and seal of the registered Professional Engineer (registered in the state or district in which the project is located).
- b. Statement that the Professional Engineer is fully experienced in the design of Metal Stairs.
- c. Statement that all calculations and shop drawings are in accordance with the Contract Documents and applicable building codes and have been prepared under the direction of the Professional Engineer.

- d. Statement that the Professional Engineer's signature and seal shall appear on all design calculations and on all shop drawings.
- e. Statement that the design shall be in accordance with the aesthetic design intent of the project with the Architect having final authority in reference to aesthetic matters.
- f. Statement that the Professional Engineer will submit an additional signed and sealed letter at the completion of the work related to this section stating that the fabrication and installation of the Metal stairs have been performed in accordance with the Professional Engineer's design.

Final Engineer Certification Letter: After construction of the metal stairs is complete, submit a signed and sealed certification letter from the responsible design professional stating that the fabrication and installation of the metal stairs have been performed in accordance with the Professional Engineer's design. Final certification letter shall be submitted for record only.

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 abrasive surfaces, or extruded aluminum with abrasive inserts, at least 4 inches wide and 1/4 inch thick for metal-pan cement-filled treads extending the full length of the tread for stairs and as indicated 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 Safety Treads

NAAMM MBG 531 steel, Plank grating ASTM A653/A653M, G-90 ASTM A1011/A1011M, steel pan for concrete tread.

2.2.2.7 Steel Framing for Concrete Stairs

When necessary, modify fabricated units to fit actual dimensions of the supporting structure. Join steel components by welding. Provide 14-gage steel risers unless otherwise indicated. Arrange components to receive finish materials as indicated.

2.2.3 Protective Coating

Shop-prime steelwork as indicated in accordance with AISC/AISI 121, except surfaces of steel encased in concrete; welded surfaces; high-strength, bolt-connected surfaces; and surfaces of crane rails.

2.3 COMPONENTS

2.3.1 Steel Stairs

Provide steel stairs complete with stringers, metal-pan concrete-filled treads, landings, columns, handrails, and necessary bolts and other fastenings.

2.3.1.1 Design Loads

Design stairs to sustain a live load of not less than 100 pounds per square foot, or a concentrated load of 300 applied where it is most critical. Except for a commercial product, design and fabricate steel stairs to conform to AISC 360. Design fire stairs to conform to NFPA 101.

2.3.1.2 Materials

Provide steel stairs of welded construction except that bolts may be used where welding is not practicable. Do not use screw or screw-type connections.

- a. Structural Steel: ASTM A36/A36M. Provide steel containing a minimum of 25 percent post-consumer recycled content. Submit data identifying percentage of recycled content for steel.
- b. Support metal pan for concrete fill on angle cleats welded to stringers or treads with integral cleats, welded or bolted to the stringer. Provide sheet-steel landings with angle stiffeners welded

on. Close exposed ends.

- c. Before fabrication, obtain necessary field measurements and verify drawing dimensions.
- d. Clean metal surfaces free of mill scale, flake rust, and rust pitting before shop finishing. Weld permanent connections. Finish welds flush and smooth on surfaces that will be exposed after installation.

2.3.2 Soffit Clips

Provide clips with holes for attaching metal furring for plastered soffits. Space the clips not more than 12 inches on center, and weld them to stair treads and platforms as required.

2.3.3 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.

2.3.4 Masonry Anchorage Devices

Provide masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488/E488M and ASTM C514 as follows:

- a. Lead expansion shields for machine screws and bolts 1/4 inch and smaller; head-out embedded-nut type, single unit class, Group I, Type 1, Class 1.
- b. Lead expansion shields for machine screws and bolts larger than 1/4 inch in size; head-out embedded-nut type, multiple unit class, Group I, Type 1, Class 2.
- c. Bolt anchor expansion shields for lag bolts; zinc-alloy, long-shield anchors class, Group II, Type 1, Class 1.
- d. Bolt anchor expansion shields for bolts; closed-end bottom-bearing class, Group II, Type 2, Class 1.

Use toggle bolts of the tumble-wing type, conforming to ASTM A325, ASTM A449, and ASTM C636/C636M, type, class, and style as required.

2.3.5 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 Galvanized Carbon Steel Sheets

Provide the following:

- a. Galvanized carbon steel sheets conforming to ASTM A653/A653M, with galvanizing conforming to ASTM A653/A653M and ASTM A924/A924M.

2.4.8 Cold-Drawn Steel Tubing

Provide the following:

- a. Cold-drawn steel tubing conforming to ASTM A512, sunk drawn, butt-welded, cold-finished, and stress-relieved.

2.4.9 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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 51 33

METAL LADDERS

02/16, CHG 2: 02/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATES
- 1.4 QUALIFICATION OF WELDERS
- 1.5 DELIVERY, STORAGE, AND PROTECTION

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Structural Carbon Steel
 - 2.1.2 Structural Tubing
 - 2.1.3 Steel Pipe
 - 2.1.4 Fittings for Steel Pipe
 - 2.1.5 Aluminum Alloy Products
- 2.2 FABRICATION FINISHES
 - 2.2.1 Galvanizing
 - 2.2.2 Galvanize
 - 2.2.3 Repair of Zinc-Coated Surfaces
 - 2.2.4 Shop Cleaning and Painting
 - 2.2.4.1 Surface Preparation
 - 2.2.4.2 Pretreatment, Priming and Painting
 - 2.2.5 Nonferrous Metal Surfaces
 - 2.2.6 Aluminum Surfaces
 - 2.2.6.1 Surface Condition
 - 2.2.6.2 Aluminum Finishes
- 2.3 LADDERS

PART 3 EXECUTION

- 3.1 GENERAL INSTALLATION REQUIREMENTS
- 3.2 WORKMANSHIP
- 3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS
- 3.4 WELDING
- 3.5 FINISHES
 - 3.5.1 Dissimilar Materials
 - 3.5.2 Field Preparation
 - 3.5.3 Environmental Conditions
- 3.6 LADDERS

-- End of Section Table of Contents --

SECTION 05 51 33

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 WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M (2019) Standard Specification for Carbon
Structural Steel

ASTM A47/A47M (1999; R 2018; E 2018) Standard
Specification for Ferritic Malleable Iron
Castings

ASTM A53/A53M (2020) Standard Specification for Pipe,
Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc
Coating (Hot-Dip) on Iron and Steel
Hardware

ASTM A500/A500M (2021) Standard Specification for
Cold-Formed Welded and Seamless Carbon
Steel Structural Tubing in Rounds and
Shapes

ASTM A653/A653M (2020) Standard Specification for Steel
Sheet, Zinc-Coated (Galvanized) or
Zinc-Iron Alloy-Coated (Galvannealed) by
the Hot-Dip Process

ASTM A780/A780M	(2020) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(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
----------------	--------------------

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

Ladders, Installation Drawings

SD-03 Product Data

Ladders

SD-07 Certificates

Fabricator Certification for 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.

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 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by Contracting Officer. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 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 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.

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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 05 - METALS

SECTION 05 52 00

METAL RAILINGS

02/18, CHG 1: 02/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 ADMINISTRATIVE REQUIREMENTS
 - 1.2.1 Preinstallation Meetings
- 1.3 SUBMITTALS
- 1.4 QUALITY CONTROL
 - 1.4.1 Welding Procedures
 - 1.4.2 Welder Qualification
 - 1.4.3 Shop Drawings
 - 1.4.4 Design Calculations
 - 1.4.4.1 Certification Letter from Contractor's Professional Engineer

PART 2 PRODUCTS

- 2.1 FABRICATION
 - 2.1.1 Steel Handrails
 - 2.1.2 Protective Coating
- 2.2 COMPONENTS
 - 2.2.1 Structural Steel Plates, Shapes And Bars
 - 2.2.2 Structural-Steel Tubing
 - 2.2.3 Steel Pipe
 - 2.2.4 Concrete Inserts
 - 2.2.5 Masonry Anchorage Devices
 - 2.2.6 Fasteners
 - 2.2.7 Steel Railings, Guardrails And Handrails
 - 2.2.7.1 Steel Handrails and Guardrails

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 INSTALLATION
 - 3.2.1 Steel Handrail and Guardrail
 - 3.2.2 Touchup Painting
- 3.3 FIELD QUALITY CONTROL
 - 3.3.1 Field Welding

-- End of Section Table of Contents --

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 314 (1990; R 2013) Standard Specification for
Steel Anchor Bolts

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2020) 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 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 (2021) Standard Specification for
Cold-Formed Welded and Seamless Carbon
Steel Structural Tubing in Rounds and
Shapes

ASTM C514 (2004; R 2020) Standard Specification for

Nails for the Application of Gypsum Board

ASTM E488/E488M

(2015) Standard Test Methods for Strength
of Anchors in Concrete and Masonry Elements

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 521

(2001; R 2012) Pipe Railing Systems Manual

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. Concrete inserts
- b. Masonry anchorage devices
- c. Protective coating
- d. Steel railings, guardrails, handrails, and brackets
- e. Anchorage and fastening systems

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Fabrication Drawings; G, AE

Iron and Steel Hardware; G

Steel Shapes, Plates, Bars and Strips; G

SD-03 Product Data

Structural Steel Plates, Shapes And Bars; G

Structural-Steel Tubing; G

Concrete Inserts; G

Masonry Anchorage Devices; G

Protective Coating; G

Steel Railings, Guardrails and Handrails; G

Anchorage and Fastening Systems; G

Recycled Content for Steel Railings; S

SD-07 Certificates

Welding Procedures; G

Welder Qualification; G

Certification Letter from Contractor's Professional Engineer; G

SD-08 Manufacturer's Instructions

Installation Instructions

1.4 QUALITY CONTROL

1.4.1 Welding Procedures

Submit results of welding procedures testing in accordance with AWS D1.1/D1.1M made in the presence of the Contracting Officer and by an approved testing laboratory at the Contractor's expense.

1.4.2 Welder Qualification

Submit certified welder qualification by tests in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test. In addition, perform tests on test pieces in positions and with clearances equivalent to those actually encountered. If a test weld fails to meet requirements, conduct an immediate retest of two test welds and ensure that each test weld passes. Failure in the immediate retest will require that the welder be retested after further practice or training and make a complete set of test welds.

1.4.3 Shop Drawings

Include plans, elevations, sections, details, and attachments to otherwork. Indicate sizes, spacing and locations of structural members. Include details of cuts, connections, splices, attachments, holes, and other pertinent data. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Indicate all AWS weld designations for pre-qualified full and partial penetration welds and detail all joint preparations. Provide erection details of all field welded connections. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Detail material required for the connection of other work. The Professional Structural Engineer's signature and seal shall appear on all

structural steel shop drawings (including erection drawings, piece drawings and connection calculations. Cloud, bubble, or otherwise highlight and identify all revisions on the drawings. Submittals which do not identify changes and revisions will be returned as "Not Reviewed". Drawings that have been renumbered will be rejected.

1.4.4 Design Calculations

Design Calculations for Metal Stairs: Design Metal railings under direct supervision of the manufacturer employed Professional Engineer. Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers and a coordinated table of contents. Design Calculations submittal shall be signed and sealed by a qualified Professional Engineer licensed in the state or district in which the project is located. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect. Design Calculations submission must be concurrent with the submission of corresponding Fabrication drawings. Fabrication drawings submitted without corresponding Design Calculations will be returned as "Not Reviewed". Design Calculations shall be submitted for information only.

1.4.4.1 Certification Letter from Contractor's Professional Engineer

Prior to the submission of Shop Drawings, Product Data, Design Calculations and other required submittals, submit a Certification Letter from the Contractor's responsible design Professional Engineer. No shop drawings will be reviewed by the Architect prior to the submission and acceptance of this Certification Letter. Certification Letter shall be submitted for information only. The Certification Letter shall include the following:

- a. Signature and seal of the registered Professional Engineer (registered in the state or district in which the project is located).
- b. Statement that the Professional Engineer is fully experienced in the design of Metal Stairs.
- c. Statement that all calculations and shop drawings are in accordance with the Contract Documents and applicable building codes and have been prepared under the direction of the Professional Engineer.
- d. Statement that the Professional Engineer's signature and seal shall appear on all design calculations and on all shop drawings.
- e. Statement that the design shall be in accordance with the aesthetic design intent of the project with the Architect having final authority in reference to aesthetic matters.
- f. Statement that the Professional Engineer will submit an additional signed and sealed letter at the completion of the work related to this section stating that the fabrication and installation of the Metal railings have been performed in accordance with the Professional Engineer's design.

Final Engineer Certification Letter: After construction of the metal railings is complete, submit a signed and sealed certification letter from the responsible design professional stating that the fabrication and installation of the metal railings have been performed in accordance with the Professional Engineer's design. Final certification letter shall be submitted for record only.

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.
- d. Provide steel containing a minimum of 25 percent recycled content. Submit data identifying percentage of recycled content for steel railings.

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 Steel Pipe

Provide pipe conforming to ASTM A53/A53M, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.2.4 Concrete Inserts

Provide threaded-type concrete inserts consisting of galvanized ferrous castings, internally threaded to receive 3/4 inch diameter machine bolts;

either malleable iron conforming to ASTM A47/A47M or cast steel conforming to ASTM A27/A27M, hot-dip galvanized in accordance with ASTM A153/A153M.

2.2.5 Masonry Anchorage Devices

Provide masonry anchorage devices consisting of expansion shields complying with AASHTO M 314, ASTM E488/E488M and ASTM C514 as follows:

Provide lead expansion shields for machine screws and bolts larger than 1/4 inch in size; head-out embedded nut type, multiple-unit class, Group I, Type 1, Class 2.

2.2.6 Fasteners

Provide galvanized zinc-coated fasteners in accordance with ASTM A153/A153M used for exterior applications or where built into exterior walls or floor systems. Select fasteners for the type, grade, and class required for the installation of steel stair items.

Provide standard hexagon-head bolts, conforming to ASTM A307, Grade A.

2.2.7 Steel Railings, Guardrails And Handrails

Design handrails to resist a concentrated load of 250 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.

2.2.7.1 Steel Handrails and Guardrails

Provide steel handrails, including inserts in concrete, steel pipe conforming to ASTM A53/A53M. Provide steel railings of 1 1/2 inch nominal size, or as indicated on the drawings.

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.

Provide galvanized exterior and interior railings where indicated, including pipe, fittings, brackets, fasteners, and other ferrous metal components. Provide black steel pipe for interior railings not indicated as galvanized.

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 per applicable details. Do not cut reinforcing when setting anchorage.
- b. 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.

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. Protective coating
- d. Masonry anchorage devices
- e. Steel railings and handrails
- f. 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 and Guardrail

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, by means of masonry with expansion shields and bolts or toggle bolts or by means of base plates bolted to stringers or structural-steel frame work. 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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

SECTION 06 10 00

ROUGH CARPENTRY

08/16, CHG 2: 11/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY AND STORAGE
- 1.4 GRADING AND MARKING
 - 1.4.1 Lumber
 - 1.4.2 Plywood
 - 1.4.3 Preservative-Treated Lumber and Plywood
 - 1.4.4 Fire-Retardant Treated Lumber
 - 1.4.5 Gypsum Board
- 1.5 SIZES AND SURFACING
- 1.6 MOISTURE CONTENT
- 1.7 PRESERVATIVE TREATMENT
- 1.8 FIRE-RETARDANT TREATMENT
- 1.9 QUALITY ASSURANCE
 - 1.9.1 Humidity Requirements
- 1.10 CERTIFICATIONS
 - 1.10.1 Certified Wood Grades
 - 1.10.2 Certified Sustainably Harvested Wood
 - 1.10.3 Indoor Air Quality Certifications
 - 1.10.3.1 Adhesives and Sealants
 - 1.10.3.2 Composite Wood, Wood Structural Panel and Agrifiber Products

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Virgin Lumber
- 2.2 LUMBER
 - 2.2.1 Framing Lumber
- 2.3 PLYWOOD
 - 2.3.1 Other Uses
 - 2.3.1.1 Plywood
- 2.4 OTHER MATERIALS
 - 2.4.1 Gypsum Wall Sheathing
 - 2.4.2 Miscellaneous Wood Members
 - 2.4.2.1 Nonstress Graded Members
 - 2.4.2.2 Blocking
 - 2.4.3 Adhesives
- 2.5 ROUGH HARDWARE
 - 2.5.1 Bolts, Nuts, Studs, and Rivets
 - 2.5.2 Anchor Bolts
 - 2.5.3 Wood Screws
 - 2.5.4 Nails
 - 2.5.5 Wire Nails

- 2.5.6 Clip Angles
- 2.5.7 Metal Framing Anchors

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Wall Sheathing
 - 3.1.1.1 Plywood
 - 3.1.1.2 Gypsum Sheathing Board
- 3.2 MISCELLANEOUS
 - 3.2.1 Wood Roof Nailers, Edge Strips, and Cants
 - 3.2.1.1 Roof Nailing Strips
 - 3.2.1.2 Roof Edge Strips and Nailers
 - 3.2.1.3 Cants
 - 3.2.2 Wood Blocking
 - 3.2.3 Wood Furring
 - 3.2.4 Temporary Closures
- 3.3 WASTE MANAGEMENT OF WOOD PRODUCTS

-- End of Section Table of Contents --

SECTION 06 10 00

ROUGH CARPENTRY

08/16, 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 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, 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 M2 (2019) Standard for the Inspection of Preservative Treated Wood Products for Industrial Use

AWPA M6 (2013) Brands Used on Preservative Treated Materials

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E445 (2002) Performance Standards and Qualification Policy for Structural-Use Panels (APA PRP-108)

APA F405	(19) Product Guide: Performance Rated Panels
APA L870	(2010) Voluntary Product Standard, PS 1-09, Structural Plywood
APA S350	(2014) PS 2-10, Performance Standard for Wood-Based Structural-Use Panels

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	(2016a) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C1396/C1396M	(2017) Standard Specification for Gypsum Board
ASTM D2898	(2010; R 2017) Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM F547	(2017) Standard Terminology of Nails for Use with Wood and Wood-Base Materials
ASTM F1667	(2020) Standard Specification for Driven Fasteners: Nails, Spikes, and Staples

FM GLOBAL (FM)

FM 4435	(2013) Roof Perimeter Flashing
---------	--------------------------------

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code
---------	------------------------------------

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	(2015) Rules for the Measurement & Inspection of Hardwood & Cypress
------------	---

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	(2013) Standard Grading Rules for Northeastern Lumber
---------------------	---

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD
ASSOCIATION (CRA)

RIS Grade Use (1998) Redwood Lumber Grades and Uses

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

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec (1986; Supple. No. 1, Aug 1993) Standard
Specifications for Grades of Southern
Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003 (2014) Standard Grading Rules for Southern
Pine Lumber

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17 (2015) Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5 (2017) Western Lumber Grading Rules

1.2 SUBMITTALS

Government approval is required for submittals with a "G" 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

Nailers and Nailing Strips; G

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-03 Product Data

Fire-retardant Treatment

Adhesives

SD-06 Test Reports

Preservative-treated Lumber and Plywood

SD-07 Certificates

Indoor Air Quality for Composite Wood; S

Certificates of Grade

Certified Sustainably Harvested Virgin Lumber; S

Certified Sustainably Harvested Framing Lumber; S

Certified Sustainably Harvested Plywood for Other Uses; S

Preservative Treatment

Indoor Air Quality for Adhesives and Sealants; S

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. Adhere to requirements for stacking, lifting, bracing, cutting, notching, and special fastening requirements. Do not use materials that have visible moisture or biological growth. Remove defective and damaged materials and provide new materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.4 GRADING AND MARKING

1.4.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency must be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view must not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

1.4.2 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark must identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA L870. Surfaces that are to be exposed to view must not bear grademarks or other types of identifying marks.

1.4.3 Preservative-Treated Lumber and Plywood

The Contractor is responsible for the quality of treated wood products. Each treated piece must be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor must provide Contracting Officer's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.4.4 Fire-Retardant Treated Lumber

Mark each piece in accordance with AWPA M6, except pieces that are to be natural or transparent finished. In addition, exterior fire-retardant lumber must be distinguished by a permanent penetrating blue stain. Labels of a nationally recognized independent testing agency will be accepted as evidence of conformance to the fire-retardant requirements of AWPA M6.

1.4.5 Gypsum Board

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
- b. Timbers 5 inches and thicker, 25 percent maximum
- c. Materials other than lumber; moisture content must be in accordance with standard under which the product is produced

1.7 PRESERVATIVE TREATMENT

- a. 0.25 pcf intended for above ground use.
- b. 0.40 pcf intended for ground contact and fresh water use. 0.60 pcf intended for Ammoniacal Copper Quaternary Compound (ACQ)-treated foundations. 0.80 to 1.00 pcf intended for ACQ-treated pilings. All wood must be air or kiln dried after treatment. Specific treatments must be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Do not incise surfaces of lumber that will be exposed. Brush coat areas that are

cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. All lumber and woodwork must be preservative treated. The following items must be preservative treated:

- (1) Wood framing, woodwork, and plywood up to and including the subflooring at the first-floor level of structures having crawl spaces when the bottoms of such items are 24 inches or less from the earth underneath.
- (2) Wood members that are in contact with water.
- (3) Wood sills, soles, plates, furring, and sleepers that are less than 24 inches from the ground, furring and nailers that are set into or in contact with concrete or masonry.
- (4) Nailers, edge strips, and cants for roof decks.

1.8 FIRE-RETARDANT TREATMENT

Fire-retardant treated wood must be pressure treated. 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.

1.9 QUALITY ASSURANCE

1.9.1 Humidity Requirements

Sequence work to minimize use of temporary HVAC to dry out building and control humidity.

1.10 CERTIFICATIONS

1.10.1 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.

1.10.2 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08 (R2013), SFI 2015-2019, or other third-party program certified by PEFC ST 2002:2020. 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 product data for certified sustainably harvested virgin lumber data.

1.10.3 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.10.3.1 Adhesives and Sealants

Provide adhesives and sealants certified to meet indoor air quality requirements by California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for adhesives and sealants.

1.10.3.2 Composite Wood, Wood Structural Panel and Agrifiber Products

For purposes of this specification, composite wood products include particleboard, medium density fiberboard, and plywood. Provide products certified to meet requirements of either California Air Resources Board (CARB) regulation Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products or California Department of Public Health (CDPH) Standard Method. Submit product data for indoor air quality for composite wood.

Exceptions: 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.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Virgin Lumber

Lumber fabricated from old growth timber is not permitted. Avoid companies who buy, sell, or use old growth timber in their operations, when possible. Provide certified sustainably harvested virgin lumber.

2.2 LUMBER

2.2.1 Framing Lumber

Framing lumber such as studs, plates, caps, collar beams, cant strips, bucks, sleepers, nailing strips, and nailers and board lumber such as subflooring and wall and roof sheathing must be one of the species listed in the table below. Minimum grade of species must be as listed. Provide certified sustainably harvested framing lumber.

<u>Table of Grades for Framing and Board Lumber</u>			
<u>Grading Rules</u>	<u>Species</u>	<u>Framing</u>	<u>Board Lumber</u>
WWPA G-5 standard grading rules	Aspen, Douglas Fir-Larch, Douglas Fir South, Engelmann Spruce-Lodgepole Pine, Engelmann Spruce, Hem-Fir, Idaho White Pine, Lodgepole Pine, Mountain Hemlock, Mountain Hemlock-Hem-Fir, Ponderosa Pine-Sugar Pine, Ponderosa Pine-Lodgepole Pine, Subalpine Fir, White Woods, Western Woods, Western Cedars, Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: No. 3 Common
WCLIB 17 standard grading rules	Douglas Fir-Larch, Hem-Fir, Mountain Hemlock, Sitka Spruce, Western Cedars, Western Hemlock	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: Standard

<u>Table of Grades for Framing and Board Lumber</u>			
<u>Grading Rules</u>	<u>Species</u>	<u>Framing</u>	<u>Board Lumber</u>
SPIB 1003 standard grading rules	Southern Pine	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	No. 2 Boards
SCMA Spec standard specifications	Cypress	No. 2 Common	No. 2 Common
NELMA Grading Rules standard grading rules	Balsam Fir, Eastern Hemlock-Tamarack, Eastern Spruce, Eastern White Pine, Northern Pine, Northern Pine-Cedar	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: No. 3 Common except Standard for Eastern White and Northern Pine
RIS Grade Use standard specifications	Redwood	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	Construction Heart

<u>Table of Grades for Framing and Board Lumber</u>			
<u>Grading Rules</u>	<u>Species</u>	<u>Framing</u>	<u>Board Lumber</u>
NHLA Rules rules for the measurement and inspection of hardwood and cypress lumber	Cypress	No. 2 Dimension	No. 2 Common

2.3 PLYWOOD

APA L870, APA S350, APA E445, and APA F405 respectively.

2.3.1 Other Uses

2.3.1.1 Plywood

C-D Grade, Exposure 1. Provide certified sustainably harvested plywood for other uses.

2.4 OTHER MATERIALS

2.4.1 Gypsum Wall Sheathing

ASTM C1396/C1396M, 5/8 inch thick; 4 feet wide with square edge for supports 16 inches o.c. with or without corner bracing of framing or for supports 24 inches o.c. with corner bracing of framing.

2.4.2 Miscellaneous Wood Members

2.4.2.1 Nonstress Graded Members

Members must include 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
Furring	1 x 3
Nailing strips	1 x 3 or 1 x 4 when used as shingle base or interior finish, otherwise 2 inch stock.

2.4.2.2 Blocking

Blocking must be standard or number 2 grade.

2.4.3 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Provide certification or validation of indoor air quality for adhesives used on the interior of the building (inside of the weatherproofing system).

2.5 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware must be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials must be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs must be hot-dip zinc-coated in accordance with ASTM A153/A153M.

2.5.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

2.5.2 Anchor Bolts

ASTM A307, size as indicated, complete with nuts and washers.

2.5.3 Wood Screws

ASME B18.6.1.

2.5.4 Nails

ASTM F547, size and type best suited for purpose. For sheathing, length of nails must be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails must be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails must be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing must be hot-dipped galvanized in accordance with ASTM A153/A153M. Nailing must be in accordance with the recommended nailing schedule contained in AWC WFCM. Where detailed nailing requirements are not specified, nail size and spacing must be sufficient to develop an adequate strength for the connection. The connection's strength must be verified against the nail capacity tables in AWC NDS. Reasonable judgment backed by experience must ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector must be used.

2.5.5 Wire Nails

ASTM F1667.

2.5.6 Clip Angles

Steel, 3/16 inch thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.5.7 Metal Framing Anchors

Construct anchors to the configuration shown using hot dip zinc-coated

steel conforming to ASTM A653/A653M, G90. Steel must be not lighter than 18 gage. Special nails supplied by the manufacturer must be used for all nailing.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Conform to AWC WFCM 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. 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. 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.

3.1.1 Wall Sheathing

3.1.1.1 Plywood

Apply horizontally or vertically. Extend sheathing over and nail to sill and top plate. Abut sheathing edges over centerlines of supports. Allow 1/8 inch spacing between panels and 1/8 inch at windows and doors. If sheathing is applied horizontally, stagger vertical end joints. Nail panels with 6-penny nails spaced 6 inches o.c. along edges of the panel and 12 inches o.c. over intermediate supports. Keep nails 3/8 inches away from panel ledges. Provide 2 by 4 blocking for horizontal edges not otherwise supported.

3.1.1.2 Gypsum Sheathing Board

Apply gypsum sheathing board either horizontally or vertically. Butt joints and locate over the centerlines of supports. Horizontally applied sheathing must be T&G, applied with tongued edge up. Stagger vertical joints and abut sheet closely to frames of openings. Nail sheathing with 11 gage, 3/8 inch head, zinc-coated nails 1-1/2 inches long for 1/2 inch sheathing and 1-3/4 inches long for 5/8 inch sheathing, spaced 3/8 inch minimum from edges. Provide 2 by 4 blocking for horizontal edges of 4 foot wide panels not otherwise supported.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.1.1 Roof Nailing Strips

Provide roof nailing strips for roof decks as indicated and specified herein. Apply nailing strips in straight parallel rows in the direction and spacing indicated. Strips must be surface applied.

a. Surface-Applied Nailers: Must be 3 inches wide and of thickness to

finish flush with the top of the insulation. Anchor strips securely to the roof deck with powder actuated fastening devices or expansion shields and bolts, spaced not more than 24 inches o.c. On decks with slopes of one inch or more, provide surface applied wood nailers for securing insulation and for nailing of roofing felts.

- b. Embedded Nailers: Must be nominal 2 by 3 with 2 inch sides beveled. Set and anchor nailers to finish flush with the roof deck surface.

3.2.1.2 Roof Edge Strips and Nailers

Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces. Except where indicated otherwise, nailers must be 6 inches wide and the same thickness as the insulation. Anchor nailers securely to underlying construction. Anchor perimeter nailers in accordance with FM 4435.

3.2.1.3 Cants

Provide wood cant strips as indicated, specified, or necessary and of lumber.

3.2.2 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.3 Wood Furring

Provide where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips must be nominal one by 3, continuous, and spaced 16 inches o.c. Erect furring vertically or horizontally as necessary. Nail furring strips to masonry. Do not use wood plugs. Provide furring strips around openings, behind bases, and at angles and corners. Furring must be plumb, rigid, and level and must be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required. Form furring for offsets and breaks in walls or ceilings on 1 by 4 wood strips spaced 16 inches o.c.

3.2.4 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof barrier partitions to isolate areas as directed.

3.3 WASTE MANAGEMENT OF WOOD PRODUCTS

In accordance with the Waste Management Plan and as specified.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

SECTION 06 41 16.00 10

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

08/10, CHG 1: 11/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
- 1.3 SUSTAINABILITY REPORTING
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 General Requirements
 - 1.5.2 Indoor Air Quality Certification
 - 1.5.3 Certified Sustainably Harvested Wood
- 1.6 DELIVERY, STORAGE, AND HANDLING
- 1.7 SEQUENCING AND SCHEDULING

PART 2 PRODUCTS

- 2.1 WOOD MATERIALS
 - 2.1.1 Lumber
 - 2.1.2 Panel Products
 - 2.1.2.1 Plywood
 - 2.1.2.2 Particleboard
 - 2.1.2.3 Medium Density Fiberboard
- 2.2 SOLID POLYMER MATERIAL
- 2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)
 - 2.3.1 Horizontal General Purpose Standard (HGS) Grade
 - 2.3.2 Vertical General Purpose Standard (VGS) Grade
 - 2.3.3 Horizontal General Purpose Postformable (HGP) Grade
 - 2.3.4 Vertical General Purpose Postformable (VGP) Grade
 - 2.3.5 Backing Sheet (BK) Grade
- 2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)
- 2.5 EDGE BANDING
- 2.6 CABINET HARDWARE
 - 2.6.1 Door Hinges
 - 2.6.2 Cabinet Pulls
 - 2.6.3 Drawer Slide
 - 2.6.4 Adjustable Shelf Support System
- 2.7 FASTENERS
- 2.8 ADHESIVES, CAULKS, AND SEALANTS
 - 2.8.1 Adhesives
 - 2.8.1.1 Wood Joinery
 - 2.8.1.2 Laminate Adhesive
 - 2.8.2 Caulk
 - 2.8.3 Sealant
- 2.9 FABRICATION
 - 2.9.1 Base and Wall Cabinet Case Body
 - 2.9.1.1 Cabinet Components
 - 2.9.1.1.1 Body Members (Ends, Divisions, Bottoms, and Tops)

- 2.9.1.1.2 Face Frames and Rails
- 2.9.1.1.3 Shelving
- 2.9.1.1.4 Cabinet Backs
- 2.9.1.1.5 Drawer Sides, Backs, and Subfronts
- 2.9.1.1.6 Drawer Bottoms
- 2.9.1.1.7 Door and Drawer Fronts
- 2.9.1.2 Joinery Method for Case Body Members
 - 2.9.1.2.1 Tops, Exposed Ends, and Bottoms
 - 2.9.1.2.2 Exposed End Corner and Face Frame Attachment
 - 2.9.1.2.2.1 Mitered Joint
 - 2.9.1.2.2.2 Non-Mitered Joint (90 degree)
 - 2.9.1.2.2.3 Butt Joint
 - 2.9.1.2.3 Cabinet Backs (Wall Hung Cabinets)
 - 2.9.1.2.3.1 Full Bound
 - 2.9.1.2.3.2 Full Overlay
 - 2.9.1.2.3.3 Side Bound
 - 2.9.1.2.4 Cabinet Backs (Floor Standing Cabinets)
 - 2.9.1.2.4.1 Side Bound
 - 2.9.1.2.4.2 Full Overlay
 - 2.9.1.2.4.3 Side Bound with Rabbets
 - 2.9.1.2.5 Wall Anchor Strips
- 2.9.2 Cabinet Floor Base
- 2.9.3 Cabinet Door and Drawer Fronts
- 2.9.4 Drawer Assembly
 - 2.9.4.1 Drawer Components
 - 2.9.4.1.1 Drawer Sides and Backs For Laminate Finish
 - 2.9.4.1.2 Drawer Sides and Back For Thermoset Decorative Overlay (Melamine) Finish
 - 2.9.4.1.3 Drawer Bottom
 - 2.9.4.2 Drawer Assembly Joinery Method
- 2.9.5 Shelving
 - 2.9.5.1 General Requirements
 - 2.9.5.2 Shelf Support System
 - 2.9.5.2.1 Recessed (Mortised) Metal Shelf Standards
- 2.9.6 Laminate Application
 - 2.9.6.1 Base/Wall Cabinet Case Body
 - 2.9.6.2 Adjustable Shelving
 - 2.9.6.2.1 Top and Bottom Surfaces
 - 2.9.6.2.2 All Edges
 - 2.9.6.3 Door, Drawer Fronts, Access Panels
 - 2.9.6.3.1 Exterior (Exposed) and Interior (Semi-Exposed) Faces
 - 2.9.6.3.2 Edges
 - 2.9.6.4 Drawer Assembly
 - 2.9.6.5 Tolerances
- 2.9.7 Finishing
 - 2.9.7.1 Filling
 - 2.9.7.2 Sanding

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Anchoring Systems
 - 3.1.1.1 Floor
 - 3.1.1.2 Wall
 - 3.1.2 Hardware
 - 3.1.3 Doors, Drawers and Removable Panels
 - 3.1.4 Plumbing Fixtures

-- End of Section Table of Contents --

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

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 ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3 (2005) Standard for High-Pressure
Decorative Laminates

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)

PEFC ST 2002:2020 (2015) PEFC International Standard Chain
of Custody of Forest Based Products

Requirements

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

SUSTAINABLE FOREST INITIATIVE (SFI)

SFI 2015-2019 (2015) Standards, Rules for Label Use, Procedures and Guidance

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED BD+C (2009; R 2010) Leadership in Energy and Environmental Design(tm) Building Design and Construction (LEED-NC)

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

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 as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. Comply with EPA requirements in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09 90 00 PAINTS AND COATINGS.

1.3 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 LEED BD+C local/regional materials, low-emitting materials, recycled content, certified wood and rapidly renewable materials requirements.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Shop Drawings
Installation

SD-03 Product Data

Wood Materials
Finish Schedule
Recycled Content for Medium Density Fiberboard; S
Recycled Content for Particleboard; S
Biobased Content for Panel Substrate; S

SD-04 Samples

Plastic Laminates
Cabinet Hardware

SD-07 Certificates

Quality Assurance
Laminate Clad Casework
Certified Sustainably Harvested Wood; S
Indoor Air Quality for Particleboard; S
Indoor Air Quality for Medium Density Fiberboard; S
Indoor Air Quality for Hardwood Plywood; S
Indoor Air Quality for Panel Substrate; S
Indoor Air Quality for Adhesives and Sealants; S

1.5 QUALITY ASSURANCE

1.5.1 General Requirements

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the premium grade quality standards as outlined in NAAWS 3.1, Section for laminate clad cabinets. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Submit a quality control statement which illustrates compliance with and understanding of NAAWS 3.1 requirements, in general, and the specific NAAWS 3.1 requirements provided in this specification. The quality control statement shall also certify a minimum of ten years Contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

1.5.2 Indoor Air Quality Certification

Submit required indoor air quality certifications in one submittal package. Provide adhesives and sealants certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Provide current product certification documentation of indoor air quality for adhesives and sealants.

Cabinets must not contain added urea formaldehyde resins including laminating adhesives for composite wood and agrifiber assemblies. For purposes of this specification, composite wood and agrifiber products include particleboard, medium density fiberboard, plywood, biobased and virgin wood panel substrates. Provide products certified to meet California Air Resources Board (CARB) regulation Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products or California Department of Public Health (CDPH) Standard Method. Submit product data for indoor air quality for particleboard, indoor air quality for medium density fiberboard, indoor air quality for hardwood plywood, and indoor air quality for panel substrate.

1.5.3 Certified Sustainably Harvested Wood

Provide wood certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08 (R2013), SFI 2015-2019, or other third-party program certified by PEFC ST 2002:2020. 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 product data for certified sustainably harvested wood.

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. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.7 SEQUENCING AND SCHEDULING

Coordinate work with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

- a. All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 3/4 inch hardwood.

2.1.2 Panel Products

2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, NAAWS 3.1 Grade AA. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

2.1.2.2 Particleboard

All particleboard shall be industrial grade, medium density (40 to 50 pounds per cubic foot), 3/4 inch thick. A moisture-resistant particleboard in grade Type 2-M-2 or 2-M-3 shall be used as the substrate for plastic laminate covered components as located on the drawings and other areas subjected to moisture. Particleboard shall meet the minimum standards listed in ASTM D1037 and CPA A208.1. Provide products with minimum 80 percent total recycled content or biobased materials. Provide data identifying percentage of recycled content for particleboard or biobased content for panel substrate.

2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate where noted on the drawings. Medium density fiberboard shall meet the minimum standards listed in CPA A208.2. Provide products with minimum 80 percent total recycled content materials. Provide data identifying percentage of recycled content for medium density fiberboard.

2.2 SOLID POLYMER MATERIAL

Solid surfacing casework components shall conform to the requirements of Section 06 61 16 SOLID SURFACING FABRICATIONS.

2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of ANSI/NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings. Submit two samples of each plastic laminate pattern and color. Samples shall be a minimum of 5 by 7 inches in size. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

2.3.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 0.048 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.3.3 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be

0.042 inches (plus or minus 0.005 inches) in thickness. This laminate grade is intended for horizontal surfaces where post forming is required.

2.3.4 Vertical General Purpose Postformable (VGP) Grade

Vertical general purpose postformable grade plastic laminate shall be 0.028 inches (plus or minus 0.004 inches) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of components where postforming is required for curved surfaces.

2.3.5 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.020 inches. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for casework cabinet interior, drawer interior, and all semi-exposed surfaces.

2.5 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be 0.020 inch 0.125 inch thick. Material width shall be 15/16 inches as indicated on the drawings. Color and pattern shall match exposed door and drawer front laminate pattern and color.

2.6 CABINET HARDWARE

Submit one sample of each cabinet hardware item specified to include hinges, pulls, and drawer glides. All hardware shall conform to ANSI/BHMA A156.9, unless otherwise noted, and shall consist of the following components:

2.6.1 Door Hinges

Self-closing type, BHMA No. B01602.

2.6.2 Cabinet Pulls

Brushed stainless steel type, 4 inch tab pulls.

2.6.3 Drawer Slide

Side mounted self-closing type, BHMA No. 05051 with full extension and a minimum 100 pound load capacity. Slides shall include an positive stop to avoid accidental drawer removal.

2.6.4 Adjustable Shelf Support System

Recessed (mortised) metal standards, BHMA No. B04071. Support clips for the standards shall be open type, BHMA No. B04091 .

2.7 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type

best suited for the purpose and shall conform to ASTM F547 where applicable.

2.8 ADHESIVES, CAULKS, AND SEALANTS

2.8.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing.

2.8.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use urea-formaldehyde resin formula or polyvinyl acetate resin emulsion. Adhesives shall withstand a bond test as described in ANSI/WDMA I.S.1A.

2.8.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be a water-based contact adhesive containing no added urea formaldehyde consistent with AWI and laminate manufacturer's recommendations. PVC edgebanding shall be adhered using a polymer-based hot melt glue.

2.8.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

2.8.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture.

2.9 FABRICATION

Verify field measurements as indicated in the shop drawings before fabrication. Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI premium grade unless otherwise indicated in this specification. Cabinet style, in accordance with NAAWS 3.1, Section 400-G descriptions, shall be flush overlay.

2.9.1 Base and Wall Cabinet Case Body

2.9.1.1 Cabinet Components

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

2.9.1.1.1 Body Members (Ends, Divisions, Bottoms, and Tops)

3/4 inch particleboard or medium density fiberboard (MDF) panel product

2.9.1.1.2 Face Frames and Rails

3/4 inch panel product

2.9.1.1.3 Shelving

3/4 inch particleboard or medium density fiberboard (MDF) panel product

2.9.1.1.4 Cabinet Backs

1/4 inch particleboard or medium density fiberboard (MDF) panel product

2.9.1.1.5 Drawer Sides, Backs, and Subfronts

1/2 inch panel product

2.9.1.1.6 Drawer Bottoms

1/4 inch particleboard or medium density fiberboard (MDF) panel product

2.9.1.1.7 Door and Drawer Fronts

3/4-inch particleboard or medium density fiberboard (MDF) panel product

2.9.1.2 Joinery Method for Case Body Members

2.9.1.2.1 Tops, Exposed Ends, and Bottoms

- a. 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.

2.9.1.2.2 Exposed End Corner and Face Frame Attachment

2.9.1.2.2.1 Mitered Joint

lock miter or spline or biscuit, glued under pressure (no visible fasteners)

2.9.1.2.2.2 Non-Mitered Joint (90 degree)

butt joint glued under pressure (no visible fasteners)

2.9.1.2.2.3 Butt Joint

glued and nailed

2.9.1.2.3 Cabinet Backs (Wall Hung Cabinets)

Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

2.9.1.2.3.1 Full Bound

Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets shall be side bound, captured in grooves; glued and fastened to top and bottom.

2.9.1.2.3.2 Full Overlay

Full overlay, plant-on backs with minimum back thickness of 1/2 inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

2.9.1.2.3.3 Side Bound

Side bound, captured in groove or rabbetts; glued and fastened.

2.9.1.2.4 Cabinet Backs (Floor Standing Cabinets)

2.9.1.2.4.1 Side Bound

Side bound, captured in grooves; glued and fastened to top and bottom.

2.9.1.2.4.2 Full Overlay

Full overlay, plant-on backs with minimum back thickness of 1/2 inch and minimum No. 12 plated (no case hardened) screws spaced a minimum 3 inches on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.

2.9.1.2.4.3 Side Bound with Rabbetts

Side bound, placed in rabbetts; glued and fastened in rabbetts.

2.9.1.2.5 Wall Anchor Strips

Wall Anchor Strips shall be required for all cabinets with backs less than 1/2 inch thick. Strips shall consist of minimum 1/2 inch thick lumber, minimum 2-1/2 inches width; securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.9.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of nominal 2 inch thick lumber or 3/4 inch particleboard. Base assembly components shall be treated lumber. Finished height for each cabinet base shall be as indicated on the drawings. Bottom edge of the cabinet door or drawer face shall be flush with top of base.

2.9.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 3/4 inch medium density particleboard or 3/4 inch medium density fiberboard (MDF. All door and drawer front edges shall be surfaced with high pressure plastic laminate, color and pattern to match exterior face laminate.

2.9.4 Drawer Assembly

2.9.4.1 Drawer Components

Drawer components shall consist of a removable drawer front, sides, backs, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

2.9.4.1.1 Drawer Sides and Backs For Laminate Finish

1/2 inch thick 7-ply hardwood veneer core substrate

2.9.4.1.2 Drawer Sides and Back For Thermoset Decorative Overlay (Melamine) Finish

1/2 inch thick medium density particleboard or MDF fiberboard substrate

2.9.4.1.3 Drawer Bottom

1/4 inch thick thermoset decorative overlay melamine panel product

2.9.4.2 Drawer Assembly Joinery Method

- a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure.
- b. Doweled, glued under pressure.
- c. Lock shoulder, glued and pin nailed.
- d. Bottoms shall be set into sides, front, and back, 1/4 inch deep groove with a minimum 3/8 inch standing shoulder.

2.9.5 Shelving

2.9.5.1 General Requirements

Shelving shall be fabricated from 3/4 inch medium density particleboard or 3/4 inch medium density fiberboard (MDF. All shelving top and bottom surfaces shall be finished with thermoset decorative overlay (melamine). Shelf edges shall be finished in a thermoset decorative overlay (melamine).

2.9.5.2 Shelf Support System

The shelf support system shall be:

2.9.5.2.1 Recessed (Mortised) Metal Shelf Standards

Mortise standards flush with the finishes surface of the cabinet interior side walls, two per side. Position and space standards on the side walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Install and adjust standards vertically to provide a level,

stable shelf surface when clips are in place.

2.9.6 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and ANSI/NEMA LD 3, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

2.9.6.1 Base/Wall Cabinet Case Body

- a. Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS .
- b. Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: Thermoset Decorative Overlay (melamine).

2.9.6.2 Adjustable Shelving

2.9.6.2.1 Top and Bottom Surfaces

Thermoset Decorative Overlay (melamine)

2.9.6.2.2 All Edges

Thermoset Decorative Overlay (melamine)

2.9.6.3 Door, Drawer Fronts, Access Panels

2.9.6.3.1 Exterior (Exposed) and Interior (Semi-Exposed) Faces

HPDL Grade VGS

2.9.6.3.2 Edges

HPDL Grade VGS

2.9.6.4 Drawer Assembly

All exterior surfaces: HPDL Grade CLS . All interior surfaces: Thermoset Decorative Overlay (melamine).

2.9.6.5 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the NAAWS 3.1 premium grade requirements.

2.9.7 Finishing

2.9.7.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

2.9.7.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for NAAWS 3.1 premium quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners. Where assembly abuts a wall surface, anchoring shall include a minimum 1/2 inch thick lumber or panel product hanging strip, minimum 2-1/2 inch width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2 Wall

Cabinet to be wall mounted shall utilize minimum 1/2 inch thick lumber or panel product hanging strips, minimum 2-1/2 inch width; securely attached to the wall side of the cabinet back, both top and bottom.

3.1.2 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, the use of plastic or synthetic insertion dowels shall be used to receive 3/16 inch "Euro screws". The use of wood screws without insertion dowels is prohibited.

3.1.3 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with NAAWS 3.1 premium 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 --

SECTION TABLE OF CONTENTS

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

SECTION 06 61 16

SOLID SURFACING FABRICATIONS

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
- 1.3 SUBMITTALS
- 1.4 CERTIFICATIONS
 - 1.4.1 Indoor Air Quality Certifications
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Qualifications
- 1.6 DELIVERY, STORAGE, AND HANDLING
- 1.7 WARRANTY

PART 2 PRODUCTS

- 2.1 MATERIAL
 - 2.1.1 Solid Surfacing Material
 - 2.1.2 Cast, 100 Percent Acrylic Polymer Solid Surfacing Material
 - 2.1.3 Material Patterns and Colors
 - 2.1.4 Surface Finish
- 2.2 ACCESSORY PRODUCTS
 - 2.2.1 Adhesives
 - 2.2.2 Seam and Sealant Emissions
 - 2.2.3 Silicone Sealant
 - 2.2.4 Conductive Tape
 - 2.2.5 Insulating Tape
 - 2.2.6 Heat Reflective Tape
 - 2.2.7 Mounting Hardware
- 2.3 FABRICATIONS
 - 2.3.1 Joints and Seams
 - 2.3.2 Edge Finishing
 - 2.3.3 Counter Top Splashes
 - 2.3.3.1 End Splashes
 - 2.3.4 Shelving
 - 2.3.5 Window Stools
 - 2.3.6 Counter Tops
 - 2.3.6.1 Counter Tops with Sinks

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Components
 - 3.1.1.1 Loose Counter Top Splashes
 - 3.1.2 Silicone Sealant
 - 3.1.3 Plumbing
- 3.2 CLEAN-UP

-- End of Section Table of Contents --

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

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 SYSTEM DESCRIPTION

- a. Work under this section includes countertops 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 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

Detail Fabrication Drawings; G

Installation; G

SD-03 Product Data

Solid Polymer; G

Indoor air quality for solid surface seam and sealant products; S

Recycled Content for Solid Surfacing Materials; S

SD-04 Samples

Material; G

Counter Tops; G

SD-06 Test Reports

Test Report Results

SD-07 Certificates

Qualifications

Indoor Air Quality for solid surface fabrication products; S

Indoor Air Quality for Solid Surfacing Materials; S

Indoor Air Quality for Solid Surface Seam Adhesive and Sealants; S

SD-10 Operation and Maintenance Data

Solid Polymer, Data Package 1; G

1.4 CERTIFICATIONS

1.4.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

Provide solid surface materials certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold. Provide current product certification documentation of indoor air quality for solid surfacing materials.

Provide solid surface seam adhesive and sealants certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Provide current product certification documentation of indoor air quality for solid surface seam adhesive and sealants.

1.5 QUALITY ASSURANCE

1.5.1 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.

1.6 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.

1.7 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials, excluding damages caused by physical or chemical abuse or excessive heat, 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. Vertical Surfaces: 1/4 inch thick material

- c. 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.
- d. d. Provide solid surfacing materials with highest recycled content feasible. Provide data identifying percentage of recycled content for solid surfacing materials.

2.1.2 Cast, 100 Percent Acrylic Polymer Solid Surfacing Material

Cast, 100 percent acrylic solid polymer material composed of acrylic polymer, mineral fillers, and pigments. Provide acrylic polymer that meets or exceeds the following minimum performance requirements:

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Tensile Strength	4000 psi (max.)	ASTM D638
Hardness	55-Barcol Impressor (min.)	ASTM D2583
Thermal Expansion	.000023 in/in/F (max.)	ASTM D696
Boiling Water Surface Resistance	No Change	ANSI/NEMA LD 3-3.05
High Temperature Resistance	No Change	ANSI/NEMA LD 3-3.06
Impact Resistance (Ball drop)		ANSI/NEMA LD 3-303
1/4 inch sheet	36-inches, 1/2 lb ball, no failure	
1/2 inch sheet	140-inches, 1/2 lb ball, no failure	
3/4 inch sheet	200-inches, 1/2 lb ball, no failure	
Mold & Mildew Growth	No growth	ASTM G21
Bacteria Growth	No growth	ASTM G21
Liquid Absorption (Weight in 24 hrs.)	0.1 percent max.	ASTM D570
Flammability		ASTM E84
Flame Spread	25 max.	
Smoke Developed	30 max.	
Sanitation	"Food Contact" approval	NSF/ANSI 51

PROPERTY	REQUIREMENT (min. or max.)	TEST PROCEDURE
Flexural Strength	10,000 psi (min.)	ASTM D790

2.1.3 Material Patterns and Colors

Provide pattern and color for all solid surfacing material components and fabrications as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers. Provide products with consistent patterned color throughout thickness of the product.

2.1.4 Surface Finish

Provide a uniform appearance on exposed finished surfaces and edges. Exposed surface finish is matte; gloss rating of 5-20.

2.2 ACCESSORY PRODUCTS

Provide accessory products, as specified below, as manufactured by the solid surfacing material manufacturer or as approved by the solid surfacing material manufacturer for use with the solid surfacing materials being specified.

2.2.1 Adhesives

Provide a two-part seam adhesive kit to create permanent, inconspicuous, non-porous, hard seams and joints by chemical bond between solid surfacing materials and components to create a monolithic appearance of the fabrication. Provide adhesive approved by the solid surfacing material manufacturer. Color-match adhesive to the surfaces being bonded where solid-colored, solid surfacing materials are being bonded together. Provide clear or color matched seam adhesive where particulate patterned, solid surfacing materials are being bonded together.

2.2.2 Seam and Sealant Emissions

Provide seam and other accessory materials that meet the emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide validation of indoor air quality for solid surface seam and sealant products.

2.2.3 Silicone Sealant

Provide silicone sealant, mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, acid-curing; ASTM C920, Type S, Grade NS, Class 25, Use NT; clear formulation; approved for use by the solid surfacing material manufacturer.

2.2.4 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 Insulating Tape

Provide manufacturer's standard insulating tape for use with drop-in food

wells used in commercial food service applications to insulate solid surfacing material from hot or cold appliances.

2.2.6 Heat Reflective Tape

Provide heat reflective tape as recommended by the solid surfacing material manufacturer for use with cutouts for heat sources.

2.2.7 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 in conformance with dimensions and shapes as indicated. Provide backsplashes and end splashes for all counter tops at locations indicated. Shop fabricate backsplashes and provide loose, to be field attached.

2.3.3.1 End Splashes

Provide end splashes loose for installation at the jobsite after horizontal surfaces to which they are to be attached have been installed.

2.3.4 Shelving

Fabricate shelving and wall support brackets from thick solid surfacing material; dimensions, edge shape, and other details as indicated.

2.3.5 Window Stools

Fabricate window stools from 1/2 inch thick solid surfacing material; dimensions, edge shape, and other details as indicated equal to the width of the window opening by a 1/2 inch overhang of the window sill depth. Provide square edge profile.

2.3.6 Counter Tops

Fabricate all solid surfacing material, counter top components from 1/2 inch or 3/4 inch thick material. Indicate details, dimensions, locations, and quantities on the drawings. Provide counter tops with 4 inch high loose as indicated. 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 edge profile, as indicated.

2.3.6.1 Counter Tops with Sinks

- a. Provide stainless steel or vitreous china sink; include cutouts to template for counter tops with sinks as furnished by the sink manufacturer. Provide manufacturer's standard sink mounting hardware for stainless steel installation. Seal between sink and counter top with specified silicone sealant. Provide sink, faucet, and plumbing requirements in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Components

Install all components and fabricated units plumb, level, and rigid. Make field joints between solid surfacing material components using solid surfacing material manufacturer's approved seam adhesives, to provide a monolithic appearance with joints inconspicuous in the finished work. Attach metal or vitreous china sinks and lavatory bowls to counter tops using solid surfacing material manufacturer's recommended clear silicone sealant and mounting hardware. Install solid polymer sinks and bowls using a color-matched seam adhesive.

3.1.1.1 Loose Counter Top Splashes

Mount loose splashes in the locations noted on the drawings. Adhere loose splashes to the counter top with a color matched silicone sealant when the solid surfacing material components are solid colors. Use a clear silicone sealant to provide adhesion of particulate patterned solid surfacing material splashes to counter tops.

3.1.2 Silicone Sealant

Use specified silicone sealant to seal all expansion joints between solid surfacing material components and all joints between solid surfacing material components and other adjacent surfaces such as walls, floors, ceiling, and plumbing fixtures. Provide sealant bead smooth and uniform in appearance and minimum size necessary to bridge any gaps between the solid surfacing material and the adjacent surface. Provide continuous bead and run the entire length of the joint being sealed.

3.1.3 Plumbing

Make plumbing connections to sinks and lavatories in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2 CLEAN-UP

Components must be cleaned after installation and covered to protect against damage during completion of the remaining project items. Damaged components must be repaired or replaced at the Contractor's sole expense.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 05 23

PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS

08/19

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 REFERENCES
- 1.3 DEFINITIONS
 - 1.3.1 Air Barrier Envelope
 - 1.3.2 Air Leakage Rate
 - 1.3.3 Bias Pressure
 - 1.3.4 Blower Door
 - 1.3.5 Environmental Separator
 - 1.3.6 Pressure Test
 - 1.3.6.1 Negative Pressure Test (Depressurization Test)
 - 1.3.6.2 Positive Pressure Test (Pressurization Test)
- 1.4 WORK PLAN
- 1.5 SUBMITTALS
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Modification of References
 - 1.6.2 Qualifications
 - 1.6.2.1 Pressure Test Agency
 - 1.6.2.2 Thermographer Qualifications
 - 1.6.3 Test Instruments and Date of Last Calibration
 - 1.6.4 Test Reports
- 1.7 CLIMATE CONDITIONS SUITABLE FOR A PRESSURE TEST
 - 1.7.1 Rain
 - 1.7.2 Wind

PART 2 PRODUCTS

- 2.1 PRESSURE TEST EQUIPMENT
 - 2.1.1 Blower Door Fans and Trailer Mounted Fans
 - 2.1.2 Digital Gages as Test Instruments
- 2.2 THERMAL IMAGING CAMERA REQUIREMENTS

PART 3 EXECUTION

- 3.1 PRESSURE TEST AGENCY
 - 3.1.1 Field Work
 - 3.1.2 Reporting Work
- 3.2 ENVELOPE SURFACE AREA CALCULATION
- 3.3 PREPARING THE BUILDING ENVELOPE FOR THE PRESSURE TEST
 - 3.3.1 Testing During Construction
 - 3.3.2 Sealing the Air Barrier Envelope
 - 3.3.3 Sealing Plumbing
 - 3.3.4 Close and Lock Doors
 - 3.3.5 Hold Excluded Building Areas at the Outdoor Pressure Level
 - 3.3.6 Maintain an Even Pressure within the Envelope

- 3.3.7 Maintain Access to Mechanical and Electrical Rooms
- 3.3.8 Minimize Potential for Blowing Dust and Debris
- 3.3.9 De-energize Air Moving Devices
- 3.3.10 Installing Blower Door Equipment in a Door Opening
- 3.4 BUILDING ENVELOPE AIR TIGHTNESS REQUIREMENT
 - 3.4.1 Architectural Only Test
 - 3.4.1.1 Test Goal
 - 3.4.1.2 Preparing the Envelope for the Pressure Test - Seal All Openings through the Air Barrier
 - 3.4.2 Architectural Plus HVAC System Test
 - 3.4.2.1 Test Goal
 - 3.4.2.2 Preparing the Building for the Pressure Test
- 3.5 CONDUCTING THE PRESSURE TEST
 - 3.5.1 Extend Pneumatic Tubes and Establish a Reference Differential Pressure
 - 3.5.2 Bias Pressure Readings
 - 3.5.3 Testing in Both Positive and Negative Directions
 - 3.5.4 Single Direction Testing
 - 3.5.5 Using a Building's Own Air Handling System to Pressure Test an Envelope
 - 3.5.5.1 Test Setup
 - 3.5.5.2 Measuring Airflows
 - 3.5.5.3 Outdoor Air Flow Measuring Stations
 - 3.5.6 Pressure Testing - Special Cases
 - 3.5.6.1 Pressure Testing a Multiple Isolated Zoned Building
 - 3.5.6.2 Pressure Testing a Building Addition
 - 3.5.7 Failed Pressure Test
 - 3.5.8 Air Leakage Test Report
- 3.6 LOCATING LEAKS BY DIAGNOSTIC TESTING
 - 3.6.1 Find Test
 - 3.6.2 Feel Test
 - 3.6.3 Infrared Thermography Test
 - 3.6.3.1 Thermography Test Methods
 - 3.6.3.1.1 Thermography Testing of the Air Barrier
 - 3.6.3.2 Thermography Test Results
 - 3.6.4 Fog Test
 - 3.6.5 Diagnostic Test Report
 - 3.6.5.1 Thermographic Investigation Report
 - 3.6.5.2 Fog Test Report
- 3.7 CALCULATION PROGRAM
- 3.8 AFTER COMPLETION OF THE PRESSURE AND/OR DIAGNOSTIC TEST
- 3.9 REPAIR AND PROTECTION
- 3.10 APPENDICES

ATTACHMENTS:

Pressure Test Data Analysis

Appendix A - Air Leakage Test Form

Appendix B - Air Leakage Test Results Form

Appendix C - Test Agency Qualifications Sheet

-- End of Section Table of Contents --

SECTION 07 05 23

PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS
08/19

PART 1 GENERAL

1.1 SUMMARY

Employ an independent agency to conduct the pressure test on the building envelope in accordance with this specification section and ASTM E779.

1.2 REFERENCES

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

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ANSI/ASNT CP-105	(2020) ASNT Standard Topical Outlines for Qualification of Nondestructive Testing Personnel
ANSI/ASNT CP-189	(2020) ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel
ASNT SNT-TC-1A	(2020) Recommended Practice for Personnel Qualification and Certification in Nondestructive Testing

ASTM INTERNATIONAL (ASTM)

ASTM D3464	(1996; R 2014) Standard Test Method for Average Velocity in a Duct Using a Thermal Anemometer
ASTM E779	(2019) Standard Test Method for Determining Air Leakage Rate by Fan Pressurization
ASTM E1186	(2017) Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
ASTM E1258	(1988; R 2018) Standard Test Method for Airflow Calibration of Fan Pressurization Devices
ASTM E1827	(2011; R 2017) Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
ASTM E2029	(2011) Standard Test Method for Volumetric and Mass Flow Rate Measurement in a Duct

Using Tracer Gas Dilution

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 6781	(1983) Thermal Insulation - Qualitative Detection of Thermal Irregularities in Building Envelopes - Infrared Method
ISO 6781-2	(2010) Performance of Buildings - Detection of Heat, Air, and Moisture Irregularities in Buildings by Infrared Methods - Part2: Equipment Requirements
ISO 6781-3	(2015) Performance of Buildings - Detection of Heat, Air, and Moisture Irregularities in Buildings by Infrared Methods - Part 3: Qualifications of Equipment Operators, Data Analysts, and Report Writers

1.3 DEFINITIONS

The following terms as they apply to this section:

1.3.1 Air Barrier Envelope

The surface that separates the inside air from the outside air. The combination of air barrier assemblies and air barrier components, connected by air barrier accessories are designed to provide a continuous barrier to the movement of air through an environmental separator. A single building may have more than one air barrier envelope. The air barrier surface includes the top, bottom, and sides of the envelope. The term "air barrier envelope" is also known as "air barrier system" or simply "air barrier".

1.3.2 Air Leakage Rate

How leaky, or conversely how air tight a building envelope is. The air leakage is normally described in terms of air flow rate for the surface area of the envelope at a defined differential pressure.

1.3.3 Bias Pressure

Also known as zero flow pressure, baseline pressure, offset pressure or background pressure. With the envelope not artificially pressurized, bias is the differential pressure that always exists between the envelope that has been prepared (sealed) for the pressure test and the outdoors. Bias pressure is made up of two components, fixed static offset (usually due to stack effect or the HVAC system) and fluctuating pressure (usually due to wind or a moving elevator). Because of pressure fluctuations many bias pressure readings are recorded and averaged for use in the calculations.

1.3.4 Blower Door

Commonly used term for an apparatus used to pressurize and depressurize the space within the building envelope and quantify air leakage through the envelope. The blower door typically includes a door fan and an air resistant fabric or a series of hard panels that extends to cover and seal the door opening between the fan shroud and door frame. The door fan is a

calibrated fan capable of measuring air flow and is usually placed in the opening of an exterior door. With the air barrier otherwise sealed, air produced by the door fan pressurizes or de-pressurizes the envelope, depending on the fan's orientation.

1.3.5 Environmental Separator

The parts of a building that separate the controlled interior environment from the uncontrolled exterior environment, or that separate spaces within a building that have dissimilar environments. The term "environmental separator" is also known as the "control layer".

1.3.6 Pressure Test

A generic term for a test in which the envelope is either pressurized or de-pressurized with respect to the outdoors.

1.3.6.1 Negative Pressure Test (Depressurization Test)

A test wherein air inside the envelope is drawn to the outdoors. This places the envelope at a lower (negative) pressure with respect to the outdoors.

1.3.6.2 Positive Pressure Test (Pressurization Test)

A test wherein outdoor air is pushed into the envelope. This air movement places the envelope at a higher (positive) pressure with respect to the outdoors.

1.4 WORK PLAN

Submit the following not later than 120 calendar days after contract award, but before start of pressure testing work, steps to be taken by the lead pressure test technician to accomplish the required testing.

a. Memorandum of test procedure.

- (1) Proposed dates for conducting the pressure, thermographic and fog tests.
- (2) Submit detailed pressure test procedures prior to the test. Provide a plan view showing proposed locations (personnel doors or other similar openings) to install blower doors or flexible ducts (for trailer-mounted fans), if used.

b. Test equipment to be used.

c. Scaffolding, scissor lifts, power, electrical extension cords, duct tape, plastic sheeting and other Contractor's support equipment required to perform all tests.

d. Other Contractor's support personnel who will be on site for testing.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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; G

SD-03 Product Data

Thermal Imaging Camera; G

SD-05 Design Data

Envelope Surface Area Calculations; G

SD-07 Certificates

Pressure Test Agency

Thermographer Qualifications

Test Instruments

Date Of Last Calibration

SD-06 Test Reports

Pressure Test Procedures; G

Air Leakage Test Report; G

Diagnostic Test Report; G

1.6 QUALITY ASSURANCE

1.6.1 Modification of References

Perform all pressure and diagnostic tests according to the referenced publications listed in paragraph REFERENCES and as modified by this section. Consider the advisory or recommended provisions, of the referred references, as mandatory.

1.6.2 Qualifications

1.6.2.1 Pressure Test Agency

Submit, no later than 15 calendar days after contract award, information certifying that the pressure test agency is not affiliated with any other company participating in work on this contract. The work of the test agency is limited to pressure testing the building envelope, performing a thermography test and fog test, and investigating, through various methods, the location of air leaks through the air barrier. See paragraph PRESSURE TEST AGENCY for additional requirements. For thermographer qualifications, see paragraph THERMOGRAPHER QUALIFICATIONS.

Use the sample TEST AGENCY QUALIFICATIONS SHEET form (Appendix C), to submit the following information.

- a. Verification of 2 years of experience as an agency in pressure testing

commercial and/or industrial buildings.

- b. List of at least ten commercial/industrial facilities with building envelopes that the agency has tested within the past 2 years. Include building name, address, and name of prime construction contractor and contractor's point-of-contact information.
- c. Confirmation of 2 years of commercial and or industrial building pressure test experience for the lead pressure test technician and the thermographer in using the specified ASTM E779 testing standard. References from five Contracting Officers for facilities where the lead test technician has supervised commercial and or industrial building pressure tests in the last 2 years.
- d. Verification that the lead pressure test technician has been employed by a building pressure testing agency in the capacity of a lead pressure test technician for not less than 1 year.

1.6.2.2 Thermographer Qualifications

To perform an infrared diagnostic evaluation, use a lead thermographer who has at least an active Level II Certification that is based on the requirements in ANSI/ASNT CP-105 or ANSI/ASNT CP-189 and is in accordance with ASNT SNT-TC-1A. The course of study is to be specifically focused on infrared thermography for building science. The thermographer must have at least two years of building science thermography experience in IR testing commercial or industrial buildings. The thermographer must also have experience in building envelopes and building science in order to make effective recommendations to the contractor should the envelope require additional sealing. Thermographic equipment operators, data analysts and report writers must comply with the requirements of ISO 6781-3. Submit the thermographer's certificate for approval. Submit a list of at least ten commercial/industrial buildings on which the thermographer has performed IR thermography in the past two years. The thermographer is to have a current active certification. Submit certification at least 60 days prior to thermography testing.

1.6.3 Test Instruments and Date of Last Calibration

Submit a signed and dated list of test instruments, their application, manufacturer, model, serial number, range of operation, accuracy and date of most recent calibration. Calibration data applicable to fan systems must be in accordance with ASTM E1258.

1.6.4 Test Reports

No later than 14 days after completion of the pressure test, submit electronic copies of an organized report. The report is to contain a table of contents, an executive summary, an introduction, a results section and a discussion of the results. Submit the air leakage test report as described in paragraph AIR LEAKAGE TEST REPORT. Submit a diagnostic test report as described in paragraph LOCATING LEAKS BY DIAGNOSTIC TESTING. The diagnostic test report is to include the Thermographic Investigation Report and the Fog Test Report (if performed).

Submit field data and completed report forms found in the appendices. Use the sample forms, Test Agency Qualification Sheet, Air Leakage Test Form and Air Leakage Test Results Form to summarize the tests for the appropriate building envelope. Submit both electronically populated and

field hand filled-in forms.

Report Data. Include in the report the following information for all tests:

- a. Date of issue
- b. Project title and number
- c. Name, address, and telephone number of testing agency
- d. Dates and locations of samples and tests or inspections
- e. Names of individuals making the inspection or test
- f. Designation of the work and test method
- g. Identification of product and specification section
- h. Complete inspection or test data
- i. Test results and an interpretation of test results
- j. Comments or professional opinion on whether inspected or tested work complies with contract document requirements
- k. Recommendations on retesting

1.7 CLIMATE CONDITIONS SUITABLE FOR A PRESSURE TEST

As the test date approaches, monitor the weather forecast for the test site. Avoid testing on days forecast to experience high winds, rain, or snow. Monitor weather forecasts prior to shipping pressure test equipment to the site. Based on current and forecast weather conditions, the Contracting Officer's representative is to grant final approval for testing to occur.

1.7.1 Rain

For safety reasons, avoid testing during rain or if rain is anticipated during testing. If pneumatic hoses are installed and exposed to rain inspect the hose to insure rainwater has not migrated into the hose ends. Orient all exposed hose ends to keep them out of water puddles. Success in temporarily sealing outdoor ventilation components such as louvers and exhaust fans may also be compromised by rain. Don't seal roof-mounted ventilation components during times of potential lightning.

1.7.2 Wind

Because wind can skew pressure test results, test only on days and at times when winds are anticipated to be the calmest. Avoid pressure testing during gusty or high wind conditions. Avoid installing test fans on the windward side of the building if wind gusts during the test are anticipated to be greater than 10 miles per hour.

PART 2 PRODUCTS

2.1 PRESSURE TEST EQUIPMENT

Depending on site conditions and size of the envelope, the test may be conducted using blower door equipment. The testing agency is to supply sufficient quantity of blower equipment that will produce a minimum of 75 Pa differential pressure between the envelope and outdoors using the test methods described herein. Supplying additional blower test equipment to provide additional airflow capacity or to act as a backup is highly recommended.

2.1.1 Blower Door Fans and Trailer Mounted Fans

Each air flow measuring system including blower door fans and trailer mounted fans are to be calibrated within the last 5 years. Calibrated blower door fans and trailer mounted fans must measure accurately to within plus or minus 5 percent of the flow reading. Blower door equipment and trailer mounted fans are to be specifically designed to pressurize building envelopes. Each set of blower door equipment is to include fan(s), digital gage(s), door frame, door fabric or hard panels.

2.1.2 Digital Gages as Test Instruments

Use only digital gages as measuring instruments in the pressure test; analog gages are not acceptable. The gauges must be accurate to within 1.0 percent of the pressure reading or 0.15 Pa, whichever is greater. Each gage is to have been calibrated within two years of the test. The calibration is to be checked against a National Institute of Standards and Technology (NIST, formerly National Bureau of Standards) traceable standard.

2.2 THERMAL IMAGING CAMERA REQUIREMENTS

The thermal imaging camera used in the thermography test must have a thermal sensitivity (Noise Equivalent Temperature Difference.) of +/- 0.18 degrees F at 86 degrees F or less. Ensure the camera's operating spectral range falls between 2 and 15 micrometers. Ensure the camera's IR image viewing screen resolution measures at least 320x240 pixels. Ensure the camera has a means of recording thermal images seen on the camera viewing screen. The camera is to display output as individual still frame images that also can be downloaded and inserted into an electronic Thermographic Investigation Report. All thermographic equipment must comply with the requirements of ISO 6781-2. Submit camera make and model, and catalog information that defines the camera thermal sensitivity for approval.

PART 3 EXECUTION

3.1 PRESSURE TEST AGENCY

The test agency is to be an independent third party subcontractor, not an affiliated or subsidiary of the prime contractor, subcontractors or A/E firm. The agency is to be regularly engaged in pressure testing of commercial/industrial building envelopes. If using blower door or trailer-mounted fans, the lead test technician must have at least two years of experience in using such equipment in building envelope pressurization tests. Formal training using pressure test equipment is highly recommended. Technicians using the building's air handling system for pressure testing are to have tested at least five

commercial/industrial buildings within the past two years with each building having over 50,000 square feet of floor area. Submit the name, address and floor areas of each of these five buildings for approval.

3.1.1 Field Work

The lead pressure test technician and thermographer are to be present at the project site while testing is performed and is to be responsible for conducting, supervising, and managing of their respective test work. Management includes health and safety of test agency employees.

3.1.2 Reporting Work

The lead pressure test technician is to prepare, sign, and date the test agenda, equipment list, and submit a certified Air Leakage Test Report. The thermographer is to prepare, sign, and date the test agenda, equipment list, and submit a certified Thermographic Investigation Report. The contractor is to prepare a final report that identifies improvements that were made to the envelope to reduce air leaks, mitigate thermal bridging, eliminate moisture migration,, repair insulation voids discovered during diagnostic tests. Jointly submit all reports.

3.2 ENVELOPE SURFACE AREA CALCULATION

The architectural air barrier boundary includes the floor, walls, and ceiling. After construction of the air barrier envelope is complete, field measure the envelope to ensure the physical measurements match the design drawings and the air barrier envelope surface area calculations are generated. If the calculation result is not within 10 percent of the defined air barrier boundary calculation result as indicated, submit the envelope surface area calculation and results for review. If the air barrier was defined during design but the air barrier envelope surface area was not calculated, calculate it during construction and submit the envelope surface area calculations and result for review.

3.3 PREPARING THE BUILDING ENVELOPE FOR THE PRESSURE TEST

3.3.1 Testing During Construction

The pressure test cannot be conducted until all components of the air barrier system have been installed. After all sealing as described herein has been completed, inspect the envelope to ensure it has been adequately prepared. During the pressure test, stop all ongoing construction within and neighboring the envelope which may impact the test or the air barrier integrity. The pressure test may be conducted before finishes that are not part of the air barrier envelope have been installed. For example, if suspended ceiling tile, interior gypsum board or cladding systems are not part of the air barrier the test can be conducted before they are installed. Recommend testing prior to installing the finished ceilings within the envelope and immediately surrounding it. The absence of finished ceilings allows for inspection and diagnostic testing of the roof/wall interface and for implementation of repairs to the air barrier, if necessary to comply with the maximum allowed leakage.

3.3.2 Sealing the Air Barrier Envelope

Seal all penetrations through the air barrier. Unavoidable penetrations due to electrical boxes or conduit, plumbing, and other assemblies that are not air tight are to be made so by sealing the assembly and the

interface between the assembly and the air barrier or by extending the air barrier over the assembly. Support the air barrier so as to withstand the maximum positive and negative air pressure to be placed on the building without displacement or damage, and transfer the load to the structure. Durably construct the air barrier to last the anticipated service life of the assembly and to withstand the maximum positive and negative pressures placed on it during pressure testing. Do not install lighting fixtures that are equipped with ventilation holes through the air barrier.

3.3.3 Sealing Plumbing

Prime all plumbing traps located within the envelope full of water.

3.3.4 Close and Lock Doors

Close and lock all doors and windows in the envelope perimeter. For doors not equipped with latching hardware, temporarily secure them in the closed position. Secure the doors in such a way that they remain fully closed even when the maximum anticipated differential air pressure produced during the test acts on them.

3.3.5 Hold Excluded Building Areas at the Outdoor Pressure Level

Keep building areas immediately surrounding but excluded from the test envelope at the outdoor pressure level during the pressure test. Maintain these areas at the outdoor pressure level by propping exterior doors open, opening windows and de-energizing all air moving devices in or serving these areas.

3.3.6 Maintain an Even Pressure within the Envelope

Ensure the pressure differences within the envelope are minimized by opening all internal air pathways including propping open all interior doors. Distribute test fans throughout the envelope as necessary to ensure the internal pressures are uniform (within 10 percent of the average differential pressure). Ideally, do not install suspended ceilings until after all pressure tests have been completed. If, however the envelope includes finished suspended ceiling spaces, temporarily remove approximately 5 percent of all ceiling tiles or a minimum of 1 tile from each isolated suspended ceiling space, whichever comprises the greatest surface area. Temporarily remove additional ceiling tiles during testing to allow for inspection and diagnostic testing of the ceiling/wall interface. An alternative to removing ceiling tiles is to measure the differential pressure between each isolated suspended ceiling space and the outdoors when the area below the suspended ceiling is maintained at a differential pressure of 75 Pa with respect to the outdoors. If the suspended ceiling differential pressure measurement is within ten percent of the 75 Pa pressure below the suspended ceiling no ceiling tiles need to be removed.

3.3.7 Maintain Access to Mechanical and Electrical Rooms

Maintain access to mechanical rooms and electrical rooms associated with the envelope to allow for de-energizing ventilation equipment and resetting circuit breakers tripped by blower door equipment, if used.

3.3.8 Minimize Potential for Blowing Dust and Debris

Because high velocity air will be blown into and out of the envelope

during the test, debris, including dust and litter, may become airborne. Airborne debris may become trapped or entangled in test equipment, thereby skewing test results. Ensure areas within and surrounding the envelope are free of dust, litter and construction materials that are easily airborne. If pressurizing existing, occupied areas, provide adequate notice to building occupants of blowing dust and debris, and general disruption of normal activities during the test.

3.3.9 De-energize Air Moving Devices

De-energize all air moving devices serving the envelope to keep air within the envelope as still as reasonably achievable. De-energize all fans that deliver air to, exhaust air from, or recirculate air within the envelope. Also de-energize all fans serving areas adjacent to but excluded from the envelope.

3.3.10 Installing Blower Door Equipment in a Door Opening

Where blower door fans are used, before installing blower door equipment, select a door opening that does not restrict air flow into and out of the envelope and has at least 5 feet clear distance in front of and behind the door opening. Disconnect the door actuator and secure the door open to prevent it from being drawn into the fan by fan pressure. Avoid installing blower door equipment on the windward side of the building.

3.4 BUILDING ENVELOPE AIR TIGHTNESS REQUIREMENT

For each building envelope, perform the Architectural Only test and if noted below, the Architectural Plus HVAC System test. The purpose of the pressure (air leakage) test is to determine final compliance with the airtightness requirement by demonstrating the performance of the continuous air barrier. An effective air barrier envelope minimizes infiltration and exfiltration through unintended air paths (leaks). The tests may be performed in any desired order.

3.4.1 Architectural Only Test

The test envelope is the architectural air barrier boundary as defined on the contract drawings. This boundary includes connecting walls, roof and floor which comprise a complete, whole, and continuous three dimensional envelope. Perform both a positive pressure test and a negative pressure test on this envelope, unless otherwise directed.

3.4.1.1 Test Goal

Input data from the test into the Air Leakage Rate by Fan Pressurization spreadsheet as described in paragraph CALCULATION PROGRAM via the Air Leakage Test Form. Compare output from the spreadsheet against the maximum allowable leakage defined in Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM. The envelope passes the test if the leakage rate, as calculated using the spreadsheet, is equal to or lower than the Architectural Only leakage rate goal.

3.4.1.2 Preparing the Envelope for the Pressure Test - Seal All Openings through the Air Barrier

Temporarily close all perimeter windows, roof hatches and doors in the envelope perimeter except for those doors that are to remain open to accommodate blower door or trailer mounted fan test equipment

installation. Seal, or isolate all other intentional openings, pathways and fenestrations through the architectural envelope prior to pressure testing. Follow the Recommended Test Envelope Conditions identified in ASTM E1827, Table 1, for the Closed Envelope condition. These openings may include boiler flues, fuel-burning water heater flues, fuel-burning kitchen equipment, clothes dryer vents, fireplaces, wall or ceiling grilles, diffusers etc. Before sealing flues, close their associated fuel valves and verify the associated pilot lights are extinguished. Prime all plumbing traps located within the envelope full of water. In lieu of applying tape and/or plastic, typical temporary sealing materials include tape and sheet plastic or a self-adhesive grille wrap. Use and apply tape and plastic in a manner that does not deface or remove paint or mar the finish of permanent surfaces. Be especially aware of residue that remains from tape applied to stainless steel surfaces such as kitchen hoods or rollup doors. For painted surfaces, use tape types that do not remove finish paint when the tape is removed. If paint is removed from the finished surface, repaint to match existing surfaces. Secure dampers closed either manually or by using the building's HVAC system controls. Use the table below for further guidance in building preparation.

Building Component	Envelope Condition
Air handling units, duct fans	As found (open) or temporarily sealed as necessary
Clothes dryer	Off
Clothes dryer vents	Temporarily sealed
Dampers - intake, exhaust	Physically closed or closed using control power or temporarily sealed
Diffusers, registers, grilles within the envelope	Temporarily sealed
Doors, personnel type, at the envelope perimeter	Secured closed
Doors, personnel type, within the envelope	Secured (propped) open
Doors, roll-up type, at the envelope perimeter	Closed (no additional sealing)
Exhaust hoods	Closed* and temporarily sealed
Fireplace hearth	Temporarily sealed *
Kitchen hoods	Temporarily sealed *
Pilot light and associated fuel valve	Extinguished and closed, respectively
Vented combustion appliance	Temporarily sealed *
Vented combustion appliance exhaust flue	Off
Windows	Secured closed

Building Component	Envelope Condition
* If the building component has an associated manual or automatic damper, consider securing the damper closed in lieu of temporarily sealing.	

3.4.2 Architectural Plus HVAC System Test

This test envelope includes the architectural air barrier boundary as defined on the contract drawings plus all HVAC supply, return and exhaust systems that penetrate and terminate within said architectural air barrier boundary and that extends outward from said boundary. All associated ductwork, intake and exhaust dampers, and air moving devices, including air handling units and fans, are included in this test envelope even if they are physically located outside of the architectural air barrier boundary. The boundary extends to and includes the low leakage intake and exhaust dampers. Perform both a positive pressure test and a negative pressure test on this envelope, unless otherwise indicated.

3.4.2.1 Test Goal

Data from the test is to be input into the Air Leakage Rate by Fan Pressurization spreadsheet as described in paragraph CALCULATION PROGRAM via the Air Leakage Test Form. If both a positive and negative pressure tests were performed, both data sets are together to be input in the spreadsheet. Compare output from the spreadsheet against the leakage rate goal. The envelope passes the test if the leakage rate, as calculated using the spreadsheet, is equal to or lower than the Architectural Plus HVAC System leakage rate goal.

3.4.2.2 Preparing the Building for the Pressure Test

In preparation of this test, de-energize all air moving devices within this envelope by putting their controls in the Unoccupied mode. This allows the building's HVAC controls to close all associated motorized intake, exhaust, and relief dampers. Make no other changes to the HVAC systems. Temporarily sealing diffusers, grilles, registers, kitchen hoods, exhaust hoods, fans, air handling units and all other HVAC system elements with tape and/or plastic sheeting or any other means is not allowed. If the envelope includes a fireplace hearth do not seal it with tape and plastic. Use the table below for further guidance in building preparation.

Building Component	Envelope Condition
Air handling units, duct fans	As found (open)
Clothes dryer	Off
Clothes dryer vents	As found (no preparation)
Dampers - intake, exhaust	As found (no preparation)

Building Component	Envelope Condition
Diffusers, registers, grilles within the envelope	As found (open)
Doors, personnel type, at the envelope perimeter	Secured closed
Doors, personnel type, within the envelope	Secured (propped) open
Doors, roll-up type, at the envelope perimeter	Closed (no preparation)
Exhaust hoods	Closed
Fireplace hearth	As found (open)
Kitchen hoods	As found (open)
Pilot light and associated fuel valve	Extinguished and closed, respectively
Vented combustion appliance	Off
Vented combustion appliance exhaust flue	As found (open)
Windows	Secured closed

3.5 CONDUCTING THE PRESSURE TEST

Notify the Contracting Officer at least 10 working days before conducting the pressure tests to provide the Government the opportunity to witness the tests and to monitor weather forecasts for conditions favorable for testing. Do not pressure test until verifying that the continuous air barrier is in place and installed without failures in accordance with installation instructions. During the pressure test periodically inspect temporarily sealed items to ensure they are still sealed. Seals on temporarily sealed items tend to release more readily at higher pressures. Test data obtained after temporarily sealed items become unsealed cannot be used as input into the calculation program. Follow the Envelope Pressure Test Procedures in the paragraphs below. Submit detailed pressure test procedures indicating the test apparatus, the test methods and procedures, and the analysis methods to be employed for the building envelope pressure (air tightness) test. Submit these procedures not later than 60 days after Notice to Proceed.

3.5.1 Extend Pneumatic Tubes and Establish a Reference Differential Pressure

Confirm the various zones within the envelope have a relatively uniform interior pressure distribution by establishing a representative differential pressure between the envelope and the outdoors with blower door or trailer-mounted fans operating. The number of indoor pressure difference measurements (pneumatic hoses) required depends on the number of interior zones separated by bottle necks that could create significant pressure drops (e.g. doorways and stairwells). Extend at least four pneumatic hoses (differential pressure monitoring ports) to locations within the envelope that are physically opposite of each other. In multiple story buildings, especially those over three stories, extend

hoses to multiple floors. Locate the hose ends away from the effects of air discharge from blower test equipment. Select one of the four (or more) interior hoses, one judged by the test agency to be the most unaffected by air velocity produced by blower test equipment, to serve as the interior reference pressure port. Extend at least one additional pneumatic hose to the outdoors (outdoor pressure port). To the end of this hose manifold at least four hoses together and terminate each hose on a different side of the building. With the envelope sealed and the blowers energized, measure the differential pressure using the interior reference pressure port and the four outdoor pressure ports. Then measure and record the differential pressure by individually using each of the remaining three interior hoses. Ensure each reading is within plus or minus 10 percent of the reference reading. Thus at an average 75 Pa maximum pressure difference across the envelope, the difference between the highest and lowest interior pressure difference measurements should be 15 Pa or less. If this condition cannot be met, attempt to create additional air pathways within the envelope to minimize pressure differences within the envelope. If necessary, move the interior hose ends. See step 2.13 of the Air Leakage Test Form in Appendix A.

3.5.2 Bias Pressure Readings

With the fan pressurization equipment de-energized and the envelope sealed, obtain the differential pressure between the outdoors and the envelope. Record 12 bias pressure readings before the pressure test and 12 bias pressure readings after the pressure test. Each reading is the average of ten or more 1-second measurements. Include positive and negative signs for each reading. To help dampen bias pressures that significantly contribute to test pressure, reduce temperature differences between indoor and outdoor air. Temperature differences can be reduced by operating test fan equipment for a few minutes to replace most of the indoor air with outdoor air.

3.5.3 Testing in Both Positive and Negative Directions

The preferred method for testing a building envelope is to test in both the pressurized and depressurized directions. Testing in one direction is only allowed if opposite direction testing cannot logistically be performed due to test equipment limitations or restrictions. After obtaining the pre-test bias differential pressure readings, conduct the pressure test. Record the envelope pressures (in units of Pascals) from one interior pneumatic hose (monitoring port) and the outdoor pneumatic hose(s), averaged or manifolded, with corresponding flows (in units of cfm) for each fan. Record the flow rates at at least 10 to 12 positive and 10 to 12 negative building pressure readings. If conducting both positive and negative pressure tests the lowest allowable test pressure is 40 Pa and the highest test pressure is 85 Pa. Keep at least 25 Pa difference between the lowest and highest test pressure readings. Include the 75 Pa pressure value between the lowest and highest readings. The 10 to 12 readings in each direction are to be roughly evenly spaced along the range of pressures and flows. After testing is complete de-energize the equipment used to provide pressurization and obtain an additional 10 to 12 post-test bias pressure readings. None of the bias pressure readings are allowed to exceed 30 percent of the minimum test pressure. If these limits are exceeded the test fails and must be repeated.

3.5.4 Single Direction Testing

After obtaining the 12 aforementioned bias pressure readings, conduct the

pressure test. Obtain flow rates at 10 to 12 roughly evenly spaced pressure readings over a pressure range of 50 to 85 Pa. After the data is recorded, de-energize the blower equipment and obtain an additional 10 to 12 bias pressure readings. None of the bias pressure readings may exceed 10 percent of the minimum test pressure. If these limits are exceeded the test fails.

3.5.5 Using a Building's Own Air Handling System to Pressure Test an Envelope

3.5.5.1 Test Setup

Temporarily seal the envelope in a manner similar to that for testing with blower door or trailer-mounted fans. To positively pressurize the envelope, de-energize all ventilation equipment and close all associated dampers, except those outside air intake dampers associated with supply fans that will be used to pressurize the building envelope. Fully open these dampers. For the negative pressure test, de-energize all ventilation equipment except for those fans that will be used to de-pressurize the envelope. All dampers associated with de-energized fans are to be closed and all exhaust dampers associated with fans used to de-pressurize the envelope will be fully opened.

3.5.5.2 Measuring Airflows

When using the building's own air handling system to pressure test the envelope, air flows can generally be measured using one of the following methods:

- a. When testing using the building's own air handling system, ensure flow readings obtained by anemometer comply with ASTM D3464. Pitot tube or hot wire anemometer traverse in accordance with ASTM D3464.
- b. Pressure compensated shrouds (especially recommended for rooftop exhaust fans)
- c. Tracer gas methods for measuring airflows in ducts in accordance with ASTM E2029. Do not use tracer gas decay, constant injection and constant concentration methods for estimating the total ventilation rate of the envelope.

3.5.5.3 Outdoor Air Flow Measuring Stations

Air flow stations may be used to measure outdoor airflows if one of the above methods is used to check accuracy of at least one air flow reading for each station or if the design of the HVAC system specifically placed outdoor air flow stations in locations that will yield accurate results. Field verify the accuracy of readings at the air flow measuring stations before obtaining pressure test readings.

3.5.6 Pressure Testing - Special Cases

3.5.6.1 Pressure Testing a Multiple Isolated Zoned Building

Pressure test each exterior corner zone plus at least an additional 20 percent (as measured by floor area) of remaining zones. The Contracting Officer is responsible for selecting which of these additional zones to test. If all zones pass the pressure test it is assumed that all untested zones also pass and no further testing is required. If, however, any zone

fails to pass the test's leakage requirements, re-seal and re-test until it passes in accordance with paragraph FAILED PRESSURE TEST. Test an additional 20 percent of previously untested zones. If all tested zones pass, no further testing is needed. If any zone in this group fails the test re-seal and re-test the zone until it passes. Continue this process until all the tested zones pass. When testing a zone, the doors to all adjacent zones that share a common surface with the tested zone are to have their doors opened to the outdoors. The resulting leakage from the test zoned is that through all 6 surfaces (4 walls, roof and floor, for a rectangular shaped zone).

3.5.6.2 Pressure Testing a Building Addition

If the existing building is occupied, coordinate the pressure test with building representatives. In preparation of the test, de-energize the air handling system serving that portion of the existing building that shares surfaces with the new building addition. Pressure testing a new building addition may also require pressurizing that part of the existing building that shares surfaces in common with the new building addition. If an air barrier is applied to the common surfaces separating the existing building from the new addition, prior to the test prop open a sufficient quantity of doors and/or windows to keep the existing building at the same pressure as the outdoors. If an air barrier is not applied to the common surfaces separating the existing building from the new addition, pressurize that part of the existing building that shares surfaces in common with the building addition to the same level as the addition using separate test pressurization equipment.

3.5.7 Failed Pressure Test

If the pressure test fails to meet the established criteria, use diagnostic test methods described in paragraph LOCATING LEAKS BY DIAGNOSTIC TESTING to discover the leak locations. Provide additional permanent sealing measures to reduce or eliminate leak sources discovered during diagnostic testing. Retest (perform another pressure test) after sealing has been completed. Repeat this sequence of documenting test results in the test report, performing diagnostic tests, documenting recommendations for additional sealing measures in the test report, sealing leak locations per recommendations, and re-testing as necessary until the building envelope passes the pressure test and is in compliance with the performance requirements.

3.5.8 Air Leakage Test Report

Report volumetric flow rates and corresponding differential pressures in cubic feet per minute (cfm) and Pascals (Pa), respectively, on the Air Leakage Test Form sample form found in Appendix A. Populate the accompanying spreadsheet file entitled Pressure Test Data Analysis with information obtained during the test. The spreadsheet uses equations found in ASTM E779 as a basis for calculating the envelope leakage rate. Other similar leakage rate calculation programs cannot be used or submitted for review. Submit a printout of the data input and output in the report. Should any air tightness (pressure) test fail, the pressure test report is to include data and results from all previous failed tests along with the final successful test data and results. Indicate if the resulting leakage rate did or did not meet the goal leakage requirement. Identify and document deficiencies in the building construction upon failure of a test to meet the specified maximum leakage rate.

Include the Test Agency Qualification Sheet, Air Leakage Test Form and Air Leakage Test Results Form in the written report. Document every test set-up condition with diagrams and photos to ensure the tests can be made repeatable. Document all pneumatic hose termination locations. Record in detail how the building envelope was prepared for the tests. Also describe in detail which building items were temporarily sealed. Include photos of test equipment and sealing measures in the report. Include an electronic (pdf) version of all test reports on a CD. If the building envelope fails to meet the leakage rate goal, provide recommendations to further seal the envelope and document these recommendations in the test report.

3.6 LOCATING LEAKS BY DIAGNOSTIC TESTING

Use diagnostic test methods described herein to discover obvious leaks through the envelope. Perform diagnostic tests on the building envelope regardless of the envelope meeting or failing to meet the designated leakage rate goal. Use diagnostic test methods in accordance with ASTM E1186 and in conjunction with pressurization equipment as necessary. Use the thermography diagnostic test to establish a baseline for envelope leakage. Apply additional diagnostic tests (find, feel, fog or other tests) as necessary to further define leak locations and pathways discovered using thermography or to find additional leaks not readily detected by thermography. Using a variety of diagnostic tests may help locate leaks that would otherwise go undetected if only a single diagnostic test were used. Pay special attention to locating leaks at interfaces where there is a change in materials or a change in direction of like materials. These interfaces, at a minimum, include roof/wall, wall/wall, floor/wall, wall/window, wall/door, wall/louver, roof mounted equipment/roof curb interfaces and all utility penetrations (ducts, pipes, conduit, etc) through the envelope's architecture. Also use diagnostic tests to check for leakage between the air duct and duct damper, when the damper, under normal control power, is placed in the closed position. Should leaks be discovered during diagnostic tests, thoroughly document their exact locations on a floor plan so that sealing can be later applied, if required or as directed. If the envelope passes the leakage test, use the diagnostic test procedure described above to identify obvious leakage locations. Seal the leaks at the discretion of the COR based on the magnitude, location, potential for liquid moisture penetration or retention, potential for condensation, presence of daylight through an architectural surface or if the leakage location could potentially cause rapid deterioration or mold growth of, or in the building envelope materials and assemblies. Apply sealing measures after diagnostic testing is complete and all pressurization blowers are off. To verify that the applied sealing measures that are effective, re-test for leaks using the same diagnostic methods that discovered the leak. Reseal and retest until the envelope meets the leakage rate goal and all obvious leaks through the envelope are sealed.

3.6.1 Find Test

Use visual observation to locate daylight and/or artificial light streaming from the opposite side of the envelope. Observe all interfaces identified above.

3.6.2 Feel Test

Use the building's air handling system or blower door equipment to negatively pressurize the building envelope, to at least 25 Pa but no

greater than 85 Pa, with respect to the outdoors. The larger the pressure difference, the easier discovering leaks by feeling them becomes. While inside the envelope, hand feel roof/wall, wall/wall, and floor/wall interfaces and utility penetrations (ducts, pipes, conduit, etc) for leaks and note the leak locations on a floor plan. The "Feel" test may also be used to check for leaks between the ductwork and ductwork damper. To do this, positively pressurize the envelope and check for air movement from the envelope exterior.

3.6.3 Infrared Thermography Test

Avoid performing thermography tests just after pressure testing the building envelope (pressurizing and/or depressurizing the building envelope) as thermography readings may be inaccurate due to excessive air-wash. Perform thermography either before the pressure test or wait an appropriate amount of time after pressure test completion for the temperatures within the building envelope to stabilize before starting the thermography tests. Coordinate thermography examination with the pressure test agency and the test agency's pressurization equipment. The pressure test agency is to allow adequate time for the thermographer to perform a complete thermographic examination, as described hereinafter, of the envelope interior and exterior.

3.6.3.1 Thermography Test Methods

Before thermographic testing, remove furniture, construction equipment, and all other obstructions both inside and outside the building as necessary to gain a clear field of view. In the Thermographic Investigation Report, document all areas where obstructions remain. For exterior thermal examination of the envelope, verify that no direct solar radiation has heated the envelope surfaces to be examined for a period of approximately 3 hours for frame construction and for approximately 8 hours for masonry veneer construction. Conduct exterior investigations after sunset, before sunrise, or on an overcast day when the influence of solar radiation can be determined to be minimal. Limit exterior examinations to times when the influence of solar radiation is minimal, such as after sunset or before sunrise or during an overcast day. Conduct thermal imaging tests only when wind speeds are less than 8 mph at the time of analysis and at the end of analysis. Document any variations in wind during the test. Document all variations of test conditions in the Thermographic Investigation Report. Test only when exterior surfaces are dry. Monitor and document ongoing test parameters, such as the temperatures inside and outside the air barrier envelope, wind speed, and differential pressure.

3.6.3.1.1 Thermography Testing of the Air Barrier

Test the building envelope in accordance with ISO 6781, and ASTM E1186. Perform a complete thermographic inspection consisting of the full inspection of the interior and exterior of the complete air barrier envelope. Document envelope areas that are inaccessible for testing. Use infrared thermography technology in concert with standard pressurization methods (blower doors, trailer mounted fans and/or the building's own air handling systems) to locate leaks through the air barrier. Because thermography works best with at least a 18 degree F temperature difference between the envelope interior and the exterior, adjust the HVAC system, if possible, to create or enhance this temperature difference. The minimum allowable temperature difference is 3 degrees F. Maintain this temperature difference for at least 3 hours prior to the test. Use

pressurization methods to establish a minimum of +20 Pa pressure difference with respect to the outdoors while using an infrared camera to view the envelope from outdoors. When viewing with the camera from inside the envelope, keep the envelope at a pressure differential of -20 Pa with respect to the outdoors using pressure testing equipment or the building's own air handling system.

3.6.3.2 Thermography Test Results

Document the location of all leaks, anomalies, and unusual thermal features on a floor plan and/or elevation view and catalog them with a visible light picture for locating the defect for correction. The thermographer is to recommend corrective actions to eliminate the leaks, anomalies and unusual thermal features. Where leaks are found perform corrective sealing as necessary to achieve the whole envelope air leakage rate specified. After sealing, again use thermography in concert with standard pressurization methods to verify that the air leakage has been reduced. After these leaks have been permanently sealed note all actions taken on the drawings or in the Thermographic Investigation Report. Submit the drawings for approval as part of the Thermographic Investigation Report. Also include thermographic photos that show where leaks were discovered. Include thermograms using an imaging palette that clearly shows the observed thermal patterns indicating air leakage. The Contracting Officer's Representative is to witness all testing.

3.6.4 Fog Test

Before using a theatrical fog generator, disable all building smoke detectors as they may alarm when fog is issued. Coordinate fog tests and the disabling of all smoke detectors with the Contracting Officer's representative and the local fire department as necessary. Use pressure test equipment or the buildings own air handling system to positively pressurize the building envelope to at least 25 Pa but not greater than 85 Pa over the outdoors. Using a theatrical fog generator within the envelope, direct fog at suspected leakage points such as at building interfaces. Test the following interfaces: roof/wall, wall/wall, floor/wall, wall/window, roof/mounted mechanical equipment. From the vantage point immediately outside the envelope and opposite that of the interface being tested, observe the effect as the fog is issued. Detection may also be further enhanced by using a scented fog liquid or a fog liquid that produces a colored fog. Look for fog and smell for associated odor percolating through the interface. Also use smoke puffers and smoke sticks as necessary to locate leaks at these and other interface locations. If the Architectural Plus HVAC System pressure test will be/was performed introduce fog into ductwork to check for leakage between ductwork and associated dampers. After fog testing has ended, reactivate the building smoke detectors and notify the Contracting Officer and local fire department that the test has ended. After sealing has been completed retest these areas using fog. Seal additional leaks that are found.

3.6.5 Diagnostic Test Report

Once the diagnostic tests have been completed and the leakage locations identified and sealed, document these procedures, locations and recommendations in the diagnostic test report. Submit plan and/or profile drawings that thoroughly identify leak locations. Describe in detail all leak locations so that the seal-up crew knows where to apply sealing measures. After sealing measures have been applied, describe the methods used along with applicable photos of the final sealed condition.

3.6.5.1 Thermographic Investigation Report

Submit a report of each thermographic investigation identifying the thermal discontinuities in the thermal control layer. Indicate in the final report locations to which improvements for both the air control layer and the thermal control layer were made to reduce air leaks and correct discontinuities in the thermal control layer. Include in the report some selected radiometric images of suspected failure points in the air barrier envelope that indicate before and after conditions. Devote a chapter(s) of the Thermographic Investigation Report to identifying suspected points of thermal bridging, moisture migration through roofs and walls, and insulation voids. Indicate in the final report improvements that were made to the envelope to reduce air leaks. Include the following items in the report:

- a. Brief description of the building construction
- b. Types of interior and exterior surface materials used in the building.
- c. Geographical orientation of the building with a description of the exterior surroundings including other buildings, vegetation, landscaping, and surface water drainage.
- d. Camera brand, model and serial number, and date of most recent calibration date; optional lenses with serial numbers (if applicable)
- e. Thermographer's and Government Inspector's names
- f. Date and time of tests
- g. Air temperature and humidity inside the air barrier envelope
- h. Outdoor air temperature and humidity
- i. General information for the last 12 hours on the solar radiation conditions in the geographic area where the test is being performed.
- j. Ambient conditions such as precipitation and wind direction and speed occurring with the last 24 hours, as applicable. Refer to specific requirements in each section of each thermographic inspection type for requirements in each specific area.
- k. Documentation of those portions of the building envelop which were not within test conditions when the scan was performed and which portions were obstructed by adjacent structures, interior furnishings, intervening cavities or reflective surfaces.
- l. Other relevant information, which may have influenced test results.
- m. Drawings, sketches, floor plans and/or photographs detailing the locations in the buildings where thermograms were taken detailing possible irregularities in the components being tested.
- n. Thermal images taken during the inspection with their relative locations and written or voiced recorded explanations of the anomaly listed along with visual and reference images.
- o. An identification of the aspects or components of the building being

examined.

- p. Explanations for the type and the extent of each construction defect observed during the inspection.
- q. Any results from additional measurements and investigations. Identify additional equipment used and support with type, model number, serial number and date of most recent calibrated.

3.6.5.2 Fog Test Report

Document all turbulent air flow and dead air spaces within the envelope. Report fog behavior as it exits from and/or is entrained within the building. Include a floor plan in the report that documents the locations where fog passed through the envelope.

3.7 CALCULATION PROGRAM

To calculate the envelope leakage rate and other required outputs, input the data obtained during the pressure tests as documented in the Air Leakage Test Form (Appendix A) into the Air Leakage Rate by Fan Pressurization Excel spreadsheet. This spreadsheet can be found at the following web site:

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic>

3.8 AFTER COMPLETION OF THE PRESSURE AND/OR DIAGNOSTIC TEST

After all pressure and/or diagnostic testing has been completed unseal all temporarily sealed items. Unless otherwise directed by the Contracting Officer, return all dampers, doors, and windows to their pre-test condition. Remove tape and plastic from all temporarily sealed openings, being careful not to deface painted surfaces. If paint is removed from finished surfaces, repaint to match existing surfaces. Unless otherwise directed by the Contracting Officer's representative, return fuel (gas) valves to their pre-test position and relight pilot lights. Return all fans and air handling units to pre-test conditions.

3.9 REPAIR AND PROTECTION

Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for testing, inspection, and similar services. Upon completion of inspection, testing, or sample taking and similar services, repair damaged construction and restore substrates and finishes, protect construction exposed by or for quality control service activities, and protect repaired construction.

3.10 APPENDICES

The following forms are available for download as a MS Word file at

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphic>

Appendix A - Air Leakage Test Form

Appendix B - Air Leakage Test Results Form

Appendix C - Test Agency Qualifications Sheet

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 13 53

ELASTOMERIC SHEET WATERPROOFING

02/16, CHG 1: 08/17

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 MANUFACTURER'S DETAILS
- 1.4 PRODUCT DATA
- 1.5 CODE REQUIREMENTS
- 1.6 DELIVERY, STORAGE, HANDLING, IDENTIFICATION
- 1.7 ENVIRONMENTAL CONDITIONS
- 1.8 SPECIAL WARRANTIES
 - 1.8.1 Guarantee
 - 1.8.2 Warranty

PART 2 PRODUCTS

- 2.1 SUSTAINABILITY CRITERIA
 - 2.1.1 Reduced Volatile Organic Compound (VOC) Content
 - 2.1.2 Recycled Content
- 2.2 MATERIALS
- 2.3 HIGH-DENSITY POLYETHYLENE (HDPE) WATERPROOFING MEMBRANE
 - 2.3.1 High-Density Polyethylene (HDPE) Waterproofing Membrane Performance Requirements
 - 2.3.2 Asphalt modified urethane membranes and tape
- 2.4 HIGH-DENSITY POLYETHYLENE (HDPE) VAPOR RETARDER / BARRIER MEMBRANE
 - 2.4.1 High-Density Polyethylene (HDPE) Vapor Retarder / Barrier Membrane performance requirements
 - 2.4.2 Asphalt modified urethane membranes and tape
 - 2.4.3 Rubberized asphalt waterproofing membrane with HDPE film performance requirements
- 2.5 Protection Board

PART 3 EXECUTION

- 3.1 VERIFICATION OF CONDITIONS
- 3.2 SURFACE PREPARATION
- 3.3 APPLICATION
 - 3.3.1 Building Envelope Requirements
 - 3.3.2 General Installation Requirements
- 3.4 FLASHING
- 3.5 HIGH-DENSITY POLYETHYLENE (HDPE)
 - 3.5.1 Installation of Vertical Applications
 - 3.5.2 Installation of Horizontal Applications
 - 3.5.3 Installation at Roll Ends and Cut Edges
- 3.6 RUBBER ASPHALT WATERPROOFING MEMBRANE WITH HIGH-DENSITY POLYETHYLENE (HDPE) CARRIER FILM
 - 3.6.1 Application, General

- 3.6.2 Application on Horizontal Surfaces
- 3.6.3 Application at Protrusions and Drains
- 3.6.4 Application on Vertical Surfaces
- 3.7 FIELD QUALITY CONTROL
- 3.8 PROTECTIVE COVERINGS

-- End of Section Table of Contents --

SECTION 07 13 53

ELASTOMERIC SHEET WATERPROOFING
02/16, CHG 1: 08/17

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM C836/C836M	(2015) High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use With Separate Wearing Course
ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D412	(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D903	(1998; R 2017) Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
ASTM D1876	(2008; R 2015; E 2015) Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)
ASTM D1970/D1970M	(2018) Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D5385/D5385M	(1993; R 2014; E 2014) Standard Test Method for Hydrostatic Pressure Resistance of Waterproofing Membranes
ASTM E96/E96M-22	(2021) Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials
ASTM E154/E154M	(2008a; R 2013; E 2013) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code
---------	------------------------------------

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

- Manufacturer's Standard Details; G
- Elastomeric Waterproofing Sheet Material; G
- Protection Board; G
- Primers, Adhesives, and Mastics; G
- Protective Coverings; G

SD-06 Test Reports

- Elastomeric Waterproofing Sheet Material; G
- Field Quality Control documentation; G

SD-07 Certificates

- Elastomeric Waterproofing Sheet Material; G
- Primers, Adhesives, and Mastics; G
- Protective Coverings; G
- Draft Special Warranties; G
- Final Special Warranties; G
- Certificates Of Compliance; G

SD-08 Manufacturer's Instructions

- Primers, Adhesives, and Mastics; G

SD-11 Closeout Submittals

- Certificates Of Compliance with sustainable requirements for items listed in SD-07; G

1.3 MANUFACTURER'S DETAILS

Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details. Include verification of existing conditions.

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for protective coverings, and manufacturer's Safety Data Sheets (SDS) for primers, adhesives, and mastics.

1.5 CODE REQUIREMENTS

Provide membrane waterproofing system in accordance with ICC IBC Section 1805 Dampproofing and Waterproofing.

1.6 DELIVERY, STORAGE, HANDLING, IDENTIFICATION

Deliver and store materials in accordance with manufacturer's printed instructions, out of the weather, in manufacturer's original packaging with brand name and product identification clearly marked. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Do not permit unidentified materials in the work area or in the project.

1.7 ENVIRONMENTAL CONDITIONS

Do not apply waterproofing during inclement weather or when there is ice, frost, surface moisture, or visible dampness on the surface to receive waterproofing for when ambient and surface temperatures are 40 degrees F or below. The restriction on the application of waterproofing materials when ambient and surface temperatures are below 40 degrees F will be waived if the Contractor devises a means, approved by the Contracting Officer in writing, of maintaining the surface and ambient temperatures above 40 degrees F.

1.8 SPECIAL WARRANTIES

1.8.1 Guarantee

Guarantee waterproofing membrane installation against failure due to leaks for a period of two years from the date of Beneficial Occupancy. Submit draft and final guarantees.

1.8.2 Warranty

Provide manufacturer's material warranty for all system components for a period of ten years from the date of Beneficial Occupancy. Submit draft and final warranties.

PART 2 PRODUCTS

2.1 SUSTAINABILITY CRITERIA

Where allowed by performance criteria:

2.1.1 Reduced Volatile Organic Compound (VOC) Content

Provide products with reduced VOC content and provide certificates of compliance in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph REDUCE VOLATILE ORGANIC COMPOUNDS.

2.1.2 Recycled Content

Provide products with recycled content and provide certificates of compliance in accordance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph RECYCLED CONTENT.

2.2 MATERIALS

Provide one of the types of elastomeric waterproofing sheet material and related primers, adhesives, and mastics as specified herein. Ensure compatibility of waterproofing materials with each other, and with materials on which they are applied. Provide materials that comply with applicable requirements cited below when tested in accordance with the referenced ASTM publications.

2.3 HIGH-DENSITY POLYETHYLENE (HDPE) WATERPROOFING MEMBRANE

2.3.1 High-Density Polyethylene (HDPE) Waterproofing Membrane Performance Requirements

- a. Thickness: ASTM D3767 Method A 0.032 in. (0.8 mm) nominal.
- b. Lateral Water Migration Resistance: ASTM D5385/D5385M Modified 1 Pass at 231 ft (71m) of hydrostatic head pressure.
- c. Low Temperature Flexibility: ASTM D1970/D1970M Unaffected at -20°F (-29°C).
- d. Resistance to Hydrostatic Head: ASTM D5385/D5385M Modified 2231 ft (71m).
- e. Elongation, ASTM D412: Modified 3500 percent.
- f. Tensile Strength, film: ASTM D41/D41M 24,000 psi (27.6 MPa).
- g. Crack Cycling at -9.4°F (-23°C), 100 Cycles: ASTM C836/C836M Unaffected, Pass.
- h. Puncture Resistance: ASTM E154/E154M 100 lbs (445 N).
- i. Peel Adhesion to Concrete: ASTM D903 Modified 45.0 lbs/in. (880 N/m).
- j. Lap Peel Adhesion at 72°F (22°C): ASTM D1876 Modified 58.0 lbs/in. (1408 N/m).
- k. Lap Peel Adhesion at 40°F (4°C): ASTM D1876 Modified 58.0 lbs/in. (1408 N/m).
- l. Permeance to water vapor transmission: ASTM E96/E96M-22 Method B 0.01 perms (0.6 ng/Pa x s x m²).

2.3.2 Asphalt modified urethane membranes and tape

Asphalt modified urethane membranes and tape for use with High-Density Polyethylene (HDPE) Waterproofing Membrane: As recommended by the High-Density Polyethylene (HDPE) Waterproofing Membrane manufacturer.

2.4 HIGH-DENSITY POLYETHYLENE (HDPE) VAPOR RETARDER / BARRIER MEMBRANE

2.4.1 High-Density Polyethylene (HDPE) Vapor Retarder / Barrier Membrane performance requirements

- a. Thickness (nominal): 0.5mm (0.021 in) ASTM D3767 Method A.
- b. Water Vapor Permeance: 0.03 perms ASTM E96/E96M-22 Method B.
- c. Tensile Strength: 65 lb./in ASTM E154/E154M.
- d. Elongation: 300% ASTM D412.
- e. Puncture Resistance: 3300 grams ASTM D1709.
- f. Peel Adhesion to Concrete: >4 lb./in ASTM D903.

2.4.2 Asphalt modified urethane membranes and tape

Asphalt modified urethane membranes and tape for use with High-Density Polyethylene (HDPE) Vapor Retarder / Barrier Membrane: As recommended by the High-Density Polyethylene (HDPE) Vapor Retarder / Barrier Membrane manufacturer.

2.4.3 Rubberized asphalt waterproofing membrane with HDPE film performance requirements

- a. Thickness: ASTM D3767 Method A 0.125 inch (1.5 mm) nominal.
- b. Low Temperature Flexibility: ASTM D1970/D1970M Unaffected at -25 degrees F (-32 degrees C).
- c. Resistance to Hydrostatic Head: ASTM D5385/D5385M Modified 231 feet (71 m).
- d. Elongation: ASTM D412 Modified 300 minimum percent.
- e. Tensile Strength, Film: ASTM D41/D41M 5,000 psi (34.5 MPa).
- f. Crack Cycling at -9.4 degrees F (-23 degrees C), 100 Cycles: ASTM C836/C836M Unaffected, Pass.
- g. Puncture Resistance: ASTM E154/E154M 50 lbs (222N).
- h. Peel Adhesion to Concrete: ASTM D903 Modified 9.0 lbs/in. (1576 N/m).
- i. Lap Peel Adhesion at minimum application temperature: ASTM D1876 Modified 5.0 lbs/in. (880 N/m).
- j. Permeance to water vapor transmission: ASTM E96/E96M-22 Method B 0.05 perms (2.9ng/Pa x s x m²).

2.5 Protection Board

Provide protection board that is compatible with the waterproofing membrane. Use a minimum 1/2 inch thick fir bitumen impregnated board 1 inch for polystyrene 1/8 inch thick for vertical and 1/4 inch for horizontal premolded bituminous protection board as recommended by the manufacturer.

Three dimensional, high impact resistant polymeric grid with woven monofilament drainage fabric bonded to the grid.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before starting the work, verify surfaces that must be waterproofed are in satisfactory condition. Notify the Contracting Officer of defects or conditions anticipated to prevent a satisfactory application. Do not start application until defects and conditions have been corrected.

3.2 SURFACE PREPARATION

Ensure surfaces to receive treatment are clean, dry, smooth, and free from deleterious materials and projections. Thoroughly wet holes, joints, cracks, and voids in concrete with water and fill with Portland cement mortar, strike flush, and permit to dry. Cut off high spots or grind smooth. Finish top surfaces of projecting masonry or concrete ledges below grade, except footings, to a steep bevel with Portland cement mortar. Sweep surfaces to receive covering before applying waterproofing to remove dust and foreign matter. Cure concrete by a method compatible with the waterproofing system.

3.3 APPLICATION

3.3.1 Building Envelope Requirements

Provide a continuous waterproofing system at all material and building transitions. Lap, wrap, fasten and seal products in accordance with manufacturer's printed instructions. Envelope assembly variations are not permitted without written approval from the Contracting Officer's Representative.

3.3.2 General Installation Requirements

Provide sheet waterproofing in accordance with manufacturer's printed installation instructions. Ensure the surface to receive membrane is clean, smooth and dry without surface irregularities; correct deficiencies prior to installation. When using solvent welding liquid, avoid prolonged contact with skin and breathing of vapor and provide adequate ventilation. Carry waterproofing of horizontal surfaces up abutting vertical surfaces and adhere solid to the substrate. Avoid wrinkles and buckles in applying membrane and joint reinforcement.

3.4 FLASHING

Flash all penetrations through the vertical and horizontal membranes with asphalt modified urethane membrane and tape, applied in accordance with the manufacturer's application instructions.

3.5 HIGH-DENSITY POLYETHYLENE (HDPE)

3.5.1 Installation of Vertical Applications

Mechanically fasten the membrane vertically using fasteners appropriate to the substrate, with the HDPE film side towards the insulation or protection board. Fasten through the selvedge using a small and low profile head fastener so that the membrane lays flat and allows firmly

rolled overlaps. Accurately position succeeding sheets to overlap the previous sheet 3 in. (75 mm) along the marked selvedge. Ensure that the underside of the succeeding sheet is clean, dry and free from contamination before attempting to overlap. Peel back and remove zip strips in the overlap area to achieve and adhesive to adhesive bond at the overlap. Roll firmly to ensure a watertight seal.

3.5.2 Installation of Horizontal Applications

Place the membrane HDPE film side to the substrate. End laps should be staggered to avoid a build-up of layers. Accurately position succeeding sheets to overlap the previous sheet 3 in. (75 mm) along the marked selvedge. Ensure the underside of the succeeding sheet is clean, dry and free from contamination before attempting to overlap. Peel back and remove zip strips in the overlap area to achieve and adhesive to adhesive bond at the overlap. Ensure a continuous bond is achieved without creases and roll firmly with a heavy roller.

3.5.3 Installation at Roll Ends and Cut Edges

Overlap all roll ends and cut edges by a minimum 3 in. (75 mm) and ensure the area is clean and free from contamination, wiping with a damp cloth if necessary. Allow to dry and apply tape centered over the lap edges and roll firmly. Immediately remove printed plastic release liner from the tape.

3.6 RUBBER ASPHALT WATERPROOFING MEMBRANE WITH HIGH-DENSITY POLYETHYLENE (HDPE) CARRIER FILM

3.6.1 Application, General

Apply surface conditioner by waterproofing manufacturer to clean, dry, frost free surfaces in accordance with manufacturer's instructions. Properly seal all joints with water stop, joint filler and sealant as required. Allow sealants to fully cure. Pre-strip all slab and wall cracks over 1/16 inch ((1.5 mm) wide and all construction and control joints with 9 inch (230 mm) wide sheet membrane strip.

3.6.2 Application on Horizontal Surfaces

Apply membrane from the low point to the high point so that laps shed water. Overlap all seams at least 2 inches (50 mm). Stagger all end laps. Roll the entire membrane firmly and completely as soon as possible. Seal all T-joints and membrane terminations with elastomeric trowel-grade flashing material by waterproofing manufacturer.

3.6.3 Application at Protrusions and Drains

Apply membrane to within 1 inch (25 mm) of the base of the protrusion, then apply elastomeric trowel-grade flashing 0.1 inch (2.5 mm) thick around protrusion and extend over the membrane a minimum of 2-1/2 inches (65 mm) and up the penetration to just below the finished height of the wearing course.

3.6.4 Application on Vertical Surfaces

Apply membrane in lengths up to 8 feet (2.5 m). Overlap all seams at least 2 inch (50 mm). On higher walls apply membrane in two or more sections with the upper overlapping the lower by at least 2 inches (50

mm). Roll all membrane with a hand roller. Terminate the membrane at grade level or extend up exterior wall and wrap under sills at First Floor.

3.7 FIELD QUALITY CONTROL

Notify the Contracting Officer 5 working days prior to date of performing tests. Before concealment, cover elastomeric waterproofing on horizontal surfaces over finished spaces with 4 inches of ponded water for 24 hours. Do not add water after start of 24 hour period. Accurately measure water level at beginning and end of 24 hour period. If water level falls, remove water and inspect waterproofing membrane. Make repairs or replacement as directed, and repeat test. Do not proceed with work that conceals membrane waterproofing before receiving approval and acceptance of the Contracting Officer.

3.8 PROTECTIVE COVERINGS

After installation has been inspected and approved by the Contracting Officer, apply a protective covering to the membrane waterproofing prior to backfilling. Protect vertical membrane waterproofing with a 1/2 inch minimum thickness of asphalt plank; 1/2 inch minimum thickness of fiberboard; or 1/8 inch minimum thickness of compatible water resistant bitumen type protection board with edges abutting adjacent edges and exposed surfaces covered by a taping system recommended by manufacturer of protection board. Cover horizontal membrane waterproofing with similar protection board and Portland cement mortar not less than 3/4 inch thick; place uniformly and allow to set before installing subsequent construction.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 21 13

BOARD AND BLOCK INSULATION

02/16, CHG 2: 08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 MANUFACTURER'S DETAILS
- 1.4 PRODUCT DATA
- 1.5 CERTIFICATIONS
 - 1.5.1 Indoor Air Quality Certification
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.6.1 Delivery
 - 1.6.2 Storage
- 1.7 SAFETY PRECAUTIONS
 - 1.7.1 Respirators
 - 1.7.2 Other Safety Considerations
- 1.8 SPECIAL WARRANTIES
 - 1.8.1 Guarantee
 - 1.8.2 Warranty

PART 2 PRODUCTS

- 2.1 BLOCK OR BOARD INSULATION
 - 2.1.1 Thermal Resistance
 - 2.1.2 Fire Protection Requirements
 - 2.1.3 Other Material Properties
 - 2.1.4 Premolded Concrete Masonry Insert
 - 2.1.5 Recycled Materials
 - 2.1.6 Indoor Air Quality
 - 2.1.7 Prohibited Materials
- 2.2 VAPOR RETARDER AND DAMPPROOFING
 - 2.2.1 Dampproofing for Masonry Cavity Walls
 - 2.2.2 Vapor Retarder under Floor Slab
- 2.3 PRESSURE SENSITIVE TAPE
- 2.4 PROTECTION BOARD OR COATING
- 2.5 ACCESSORIES
 - 2.5.1 Adhesive
 - 2.5.2 Mechanical Fasteners

PART 3 EXECUTION

- 3.1 EXISTING CONDITIONS
- 3.2 PREPARATION
 - 3.2.1 Blocking Around Heat Producing Devices
- 3.3 INSTALLATION
 - 3.3.1 Installation and Handling
 - 3.3.2 Electrical Wiring
 - 3.3.3 Cold Climate Requirement

- 3.3.4 Continuity of Insulation
- 3.3.5 Coordination
- 3.4 INSTALLATION ON WALLS
 - 3.4.1 Installation using Furring Strips
 - 3.4.2 Installation on Masonry Walls
 - 3.4.3 Adhesive Attachment to Concrete and Masonry Walls
 - 3.4.4 Mechanical Attachment on Concrete and Masonry Walls
 - 3.4.5 Protection Board or Coating
- 3.5 INSTALLATION ON UNDERSIDE OF CONCRETE FLOOR SLAB
 - 3.5.1 Mechanically Fastened Systems
 - 3.5.2 Adhesively Bonded Systems
- 3.6 PERIMETER INSULATION
 - 3.6.1 Manufacturer's Instructions
 - 3.6.2 Insulation on Vertical Surfaces
 - 3.6.3 Protection of Insulation
- 3.7 VAPOR RETARDER
- 3.8 ACCESS PANELS AND DOORS

-- End of Section Table of Contents --

SECTION 07 21 13

BOARD AND BLOCK INSULATION

02/16, CHG 2: 08/20

PART 1 GENERAL

1.1 REFERENCES

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

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 1-4 2020; Interpretation 5-8 2021; Addenda AS-CB 2022) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM C165	(2007; R 2017) Standard Test Method for Measuring Compressive Properties of Thermal Insulations
ASTM C272/C272M	(2016) Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions
ASTM C578	(2019) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C930	(2019) Standard Classification of Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D1621	(2016) Standard Test Method for Compressive Properties of Rigid Cellular Plastics
ASTM D3833/D3833M	(1996; R 2011) Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM E154/E154M	(2008a; R 2013; E 2013) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code
---------	------------------------------------

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2020) Standard for the Installation of Oil-Burning Equipment
NFPA 54	(2021) National Fuel Gas Code
NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 211	(2019) Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

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 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

Manufacturer's Standard Details; G

Block or Board Insulation; G

Pressure Sensitive Tape; G

Protection Board or Coatings; G

Accessories including sealants; G

Recycled Content for Block or Board Insulation; S

SD-07 Certificates

Block or Board Insulation; G

Vapor Retarder; G

Protection Board or Coating; G

Draft Special Warranties; G

Final Special Warranties; G

Indoor Air Quality For Block Or Board Insulation; S

Indoor Air Quality for Adhesive; S

SD-08 Manufacturer's Instructions

Block or Board Insulation

Adhesive

1.3 MANUFACTURER'S DETAILS

Submit manufacturer's standard details indicating methods of attachment and spacing, transition and termination details, and installation details. Include verification of existing conditions.

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for protection board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.5 CERTIFICATIONS

1.5.1 Indoor Air Quality Certification

Submit required indoor air quality certifications in one submittal package.

Provide insulation installed within the interior of the building (inside of the weatherproofing system) certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold. Submit product data for indoor air quality for block or board insulation.

Provide adhesive applied within the interior of the building (inside of the weatherproofing system) certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of

SCAQMD Rule 1168. Submit product data for indoor air quality for adhesive.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver materials to the site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.6.2 Storage

Inspect materials delivered to the site for damage and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Comply with manufacturer's recommendations for handling, storage, and protection of materials before and during installation.

1.7 SAFETY PRECAUTIONS

1.7.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by the National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) and in accordance with 29 CFR 1910.134.

1.7.2 Other Safety Considerations

Comply with the safety requirements of ASTM C930.

1.8 SPECIAL WARRANTIES

1.8.1 Guarantee

Guarantee insulation installation against failure due to ultraviolet light exposure for a period of three years from the date of Beneficial Occupancy or Substantial Completion. Submit draft and final guarantees in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.8.2 Warranty

Provide manufacturer's material warranty for all system components for a period of three years from the date of Beneficial Occupancy or Substantial Completion. Submit draft and final warranties in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 2 PRODUCTS

2.1 BLOCK OR BOARD INSULATION

Provide thermal insulating materials as recommended by manufacturer for

each type of application indicated. Provide insulation with the following physical properties and in accordance with the following standards:

- a. Extruded Preformed Cellular Polystyrene: ASTM C578 REV A
- b. Mineral Fiber Block and Board: ASTM C612

2.1.1 Thermal Resistance

Unless otherwise indicated, Roof R-30 c.i. Wall R-11.4 c.i. and R-10 c.i. and R-13, as indicated in accordance with ASHRAE 90.1 - IP for Climate Zone 5.

2.1.2 Fire Protection Requirements

- a. Flame spread index of 75 or less when tested in accordance with ASTM E84.
- b. Smoke developed index of 165 or less when tested in accordance with ASTM E84.
- c. Provide insulated assemblies in accordance ICC IBC Chapter Fire and Smoke Protection Features.

2.1.3 Other Material Properties

Provide thermal insulating materials with the following properties:

- a. Rigid cellular plastics: Compressive Resistance at Yield: Not less than 25 pounds per square inch (psi) when measured according to ASTM D1621.
- b. Mineral fiber board: Compressive strength: Minimum load required to produce a reduction in thickness of 10 percent pounds per square foot (lbf/sf): 1000 when tested according to ASTM C165.
- c. Water Vapor Permeance: Not more than 1.0 perms or less when measured according to ASTM E96/E96M, desiccant method, in the thickness required to provide the specified thermal resistance, including facings, if any.
- d. Water Absorption: Not more than 0.3 percent by total immersion, by volume, when measured according to ASTM C272/C272M.

2.1.4 Premolded Concrete Masonry Insert

Provide in accordance with ASTM C578 REV A. Provide inserts in concrete masonry units that are installed at the masonry unit manufacturing plant. Provide insert with thickness of not less than 1 1/4 inches.

2.1.5 Recycled Materials

Provide thermal insulation containing recycled materials to the extent practicable, provided that the material meets all other requirements of this section. The minimum required recycled material contents (by weight, not volume) are:

Polyisocyanurate/Polyurethane:	9 percent
Phenolic Rigid Foam:	5 percent
Perlite Board:	75 percent post consumer paper

Provide data identifying percentage of recycled content for block or board insulation.

2.1.6 Indoor Air Quality

Provide certification of indoor air quality for block or board insulation and adhesive.

2.1.7 Prohibited Materials

Do not provide materials containing asbestos.

2.2 VAPOR RETARDER AND DAMPPROOFING

2.2.1 Dampproofing for Masonry Cavity Walls

Provide combined air barrier and vapor retarder system. Refer to Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEMS and as indicated on the drawings.

2.2.2 Vapor Retarder under Floor Slab

- a. Water vapor permeance: 0.1 Perm or less when tested in accordance with ASTM E96/E96M.
- b. Puncture resistance: Maximum load no less than 40 pounds when tested according to ASTM E154/E154M REV A.

2.3 PRESSURE SENSITIVE TAPE

As recommended by manufacturer of vapor retarder(s). Match water vapor permeance rating for each vapor retarder specified. Provide tape in accordance with ASTM D3833/D3833M.

2.4 PROTECTION BOARD OR COATING

As recommended by insulation manufacturer.

2.5 ACCESSORIES

2.5.1 Adhesive

As recommended by insulation manufacturer.

2.5.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Prior to installation, ensure all areas that are in contact with the insulation are dry and free of projections that could cause voids, compressed insulation, or punctured vapor retarders. For foundation perimeter or under slab applications, check that subsurface fill is flat, smooth, dry, and well tamped. Do not proceed with installation if moisture or other conditions are present, and notify the Contracting Officer of such conditions. Do not proceed with the work until conditions have been corrected and verified to be dry.

3.2 PREPARATION

3.2.1 Blocking Around Heat Producing Devices

Provide noncombustible blocking at all spaces between heat producing devices and the floors, ceilings and roofs through which they pass. Provide in accordance with ICC IBC Section 2111.12 Fireplace Blocking and with the following clearances:

- a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless certified for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by NFPA 70 and, if insulation is placed above fixture or device, 24 inches above fixture.
- b. Masonry chimneys or masonry enclosing a flue: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.
- c. Vents and vent connectors used for venting products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.
- d. Gas Fired Appliances: Clearances as required in NFPA 54.
- e. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking is not required if chimneys or flues are certified in writing by the chimney or flue manufacturer for use in contact with specific insulating materials.

3.3 INSTALLATION

3.3.1 Installation and Handling

Provide insulation in accordance with the manufacturer's printed installation instructions. Keep material dry and free of extraneous materials.

3.3.2 Electrical Wiring

Do not install insulation in a manner that would enclose electrical wiring between two layers of insulation.

3.3.3 Cold Climate Requirement

Place insulation on the outside of pipes.

3.3.4 Continuity of Insulation

Butt tightly against adjoining boards, studs, rafters, joists, sill plates, headers and obstructions. Provide continuity and integrity of insulation at corners, wall to ceiling joint, roof, and floor. Avoid creating thermal bridges and voids. Provide and verify continuity of insulative barrier throughout the building enclosure.

3.3.5 Coordination

Verify final installed insulation thicknesses comply with thicknesses indicated, R-values specified herein, and with the approved insulation submittal(s).

3.4 INSTALLATION ON WALLS

3.4.1 Installation using Furring Strips

Install insulation between members as recommended by insulation manufacturer.

3.4.2 Installation on Masonry Walls

Apply board directly to masonry with adhesive or fasteners as recommended by the insulation manufacturer. Fit between obstructions without impaling board on ties or anchors. Apply in parallel courses with joints breaking midway over course below. Place boards in moderate contact with adjoining insulation without forcing and without gaps. Cut and shape as required to fit around wall penetrations, projections or openings to accommodate conduit or other utilities. Seal around cutouts with sealant. Install insulation in wall cavities so that it leaves at least a nominal 1 inch air space outside of the insulation to allow for cavity drainage.

3.4.3 Adhesive Attachment to Concrete and Masonry Walls

Apply adhesive to wall and completely cover wall with insulation.

a. As recommended by the insulation manufacturer.

3.4.4 Mechanical Attachment on Concrete and Masonry Walls

Cut insulation to cover walls. Apply adhesive to wall and set clip or other mechanical fastener in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners and bend split prongs to provide a flush condition with the insulation. Butt all edges of insulation and seal with tape.

3.4.5 Protection Board or Coating

Install protection board or coating in accordance with manufacturer's printed instructions. Install protection over all exterior exposed insulation and to 1 foot below grade.

3.5 INSTALLATION ON UNDERSIDE OF CONCRETE FLOOR SLAB

3.5.1 Mechanically Fastened Systems

Size insulation to cover underside of slab. Apply adhesive to slab and set fasteners in adhesive as recommended by manufacturer. After curing of adhesive, install insulation over fasteners and bend split prongs to provide a flush condition with the insulation. Butt all edges of insulation and seal with tape.

3.5.2 Adhesively Bonded Systems

Apply adhesive to underside of slab and completely cover wall with insulation.

- a. As recommended by insulation manufacturer.

3.6 PERIMETER INSULATION

Install perimeter thermal insulation where heated spaces are adjacent to exterior walls, slab edges in slab-on-grade, or floating slab construction.

3.6.1 Manufacturer's Instructions

Layout insulation, tape edges, provide vapor retarder and other required accessories to protection against vermin, insects, and damage in accordance with manufacturer's printed instructions.

3.6.2 Insulation on Vertical Surfaces

Provide thermal insulation on exterior of foundation walls on grade beams below grade and on edges of slabs-on-grade. Fasten insulation with adhesive or mechanical fasteners.

3.6.3 Protection of Insulation

Protect insulation from damage during construction and back filling by application of protection board or a coating. Do not leave installed vertical insulation unprotected overnight. Protect installed insulation from weather, including rain and ultraviolet light, from mechanical abuse, compression, and dislocation. Install protection over entire exposed exterior insulation board. Extend protection at least 1 foot below grade.

3.7 VAPOR RETARDER

Apply vapor retarder continuous across all surfaces. Overlap all joints at least 6 inches and seal with pressure sensitive tape. Seal at sills, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

3.8 ACCESS PANELS AND DOORS

Attach insulation to all access panels greater than 1 square foot and all access doors in insulated floors and ceilings. Use insulation with same R-Value as that for the floor or ceiling in which each panel occurs.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION

11/11, CHG 4: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Insulation Products
 - 1.3.2 Adhesives and Sealants
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - 1.4.1 Delivery
 - 1.4.2 Storage
- 1.5 SAFETY PRECAUTIONS
 - 1.5.1 Respirators
 - 1.5.2 Other Safety Concerns

PART 2 PRODUCTS

- 2.1 BLANKET INSULATION
 - 2.1.1 Thermal Resistance Value (R-VALUE)
 - 2.1.2 Recycled Materials
 - 2.1.3 Prohibited Materials
 - 2.1.4 Reduced Volatile Organic Compounds (VOC) for Insulation Materials
 - 2.1.5 SOUND ATTENUATION BLANKETS (SAFB)
- 2.2 BLOCKING
- 2.3 ACCESSORIES
 - 2.3.1 Adhesive
 - 2.3.2 Mechanical Fasteners
 - 2.3.3 Wire Mesh

PART 3 EXECUTION

- 3.1 EXISTING CONDITIONS
- 3.2 PREPARATION
 - 3.2.1 Blocking at Attic Vents and Access Doors
 - 3.2.2 Blocking Around Heat Producing Devices
- 3.3 INSTALLATION
 - 3.3.1 Insulation
 - 3.3.1.1 Electrical wiring
 - 3.3.1.2 Continuity of Insulation
 - 3.3.1.3 Installation at Bridging and Cross Bracing
 - 3.3.1.4 Cold Climate Requirement
 - 3.3.1.5 Sizing of Blankets
 - 3.3.1.6 Special Requirements for Floors
 - 3.3.1.7 Access Panels and Doors
 - 3.3.2 Installation of Separate Vapor Retarder

-- End of Section Table of Contents --

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 D5359	(2015) Standard Specification for Glass Cullet Recovered from Waste for Use in Manufacture of Glass Fiber
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
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
-------	-------------------------------------

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2020) Standard for the Installation of Oil-Burning Equipment
NFPA 54	(2021) National Fuel Gas Code
NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)

National Electrical Code

NFPA 211 (2019) Standard for Chimneys, Fireplaces,
Vents, and Solid Fuel-Burning Appliances

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 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

Blanket Insulation

Recycled Content for Insulation Materials; S

Vapor Retarder

Pressure Sensitive Tape

Accessories

SD-07 Certificates

Indoor Air Quality for Insulation Materials; S

Indoor Air Quality for Adhesives; S

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 BLANKET INSULATION

ASTM C665, Type I, blankets without membrane coverings, except a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E84.

2.1.1 Thermal Resistance Value (R-VALUE)

The R-Value must be as indicated on drawings.

2.1.2 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.

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

2.1.4 Reduced Volatile Organic Compounds (VOC) for Insulation Materials

Provide certification of indoor air quality for insulation materials.

2.1.5 SOUND ATTENUATION BLANKETS (SAFB)

See Section 09 29 00 GYPSUM BOARD.

2.2 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E136 for blocking around chimneys and heat producing devices.

2.3 ACCESSORIES

2.3.1 Adhesive

As recommended by the insulation manufacturer. Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.3.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.3.3 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify Contracting Officer of such conditions.

3.2 PREPARATION

3.2.1 Blocking at Attic Vents and Access Doors

Prior to installation of insulation, install permanent blocking to prevent insulation from slipping over, clogging, or restricting air flow through soffit vents at eaves. Install permanent blocking around attic trap doors.

Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

3.2.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

- a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by 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: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.
- c. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.
- d. Gas Fired Appliances: Clearances as required in NFPA 54.
- e. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking around flues and chimneys is not required when insulation blanket, including any attached vapor retarder, passed ASTM E136, in addition to meeting all other requirements stipulated in Part 2. Blocking is also not required if the chimneys are certified by the manufacturer for use in contact with insulating materials.

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 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.

3.3.1.6 Special Requirements for Floors

Hold insulation in place with corrosion resistant wire mesh, wire fasteners, or wire lacing.

3.3.1.7 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.

3.3.2 Installation of Separate Vapor Retarder

Apply continuous vapor retarder as indicated. Overlap joints at least 6 inches and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 22 00

ROOF AND DECK INSULATION

02/16, CHG 3: 11/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 SHOP DRAWINGS
- 1.4 PRODUCT DATA
- 1.5 MANUFACTURER'S INSTRUCTIONS
- 1.6 QUALITY CONTROL
- 1.7 FM APPROVAL REQUIREMENTS
- 1.8 FIRE PERFORMANCE REQUIREMENTS
 - 1.8.1 Insulation in Roof Systems
- 1.9 DELIVERY, STORAGE, AND HANDLING
 - 1.9.1 Delivery
 - 1.9.2 Storage and Handling
- 1.10 ENVIRONMENTAL CONDITIONS
- 1.11 PROTECTION
 - 1.11.1 Completed Work

PART 2 PRODUCTS

- 2.1 INSULATION
 - 2.1.1 Insulation Types
 - 2.1.2 Recycled Materials
 - 2.1.3 Insulation Thickness
 - 2.1.4 Tapered Roof Insulation for insulation crickets
- 2.2 COVER BOARD
 - 2.2.1 Glass Mat Gypsum Roof Board
- 2.3 FASTENERS
 - 2.3.1 Fasteners for Steel Decks
- 2.4 WOOD NAILERS

PART 3 EXECUTION

- 3.1 EXAMINATION AND PREPARATION
 - 3.1.1 Surface Inspection
 - 3.1.2 Surface Preparation
- 3.2 INSULATION INSTALLATION
 - 3.2.1 Installation Using Only Mechanical Fasteners
 - 3.2.2 Special Precautions for Installation of Foam Insulation
 - 3.2.2.1 Polyisocyanurate Insulation
- 3.3 PROTECTION
 - 3.3.1 Protection of Applied Insulation
 - 3.3.2 Damaged Work and Materials
- 3.4 INSPECTION

-- End of Section Table of Contents --

SECTION 07 22 00

ROOF AND DECK INSULATION
02/16, 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 C1177/C1177M	(2017) Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C1289	(2020) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4450	(1989) Approval Standard for Class 1 Insulated Steel Deck Roofs
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code
---------	------------------------------------

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Insulation Board Layout and Attachment; G

Verification of Existing Conditions; G

SD-03 Product Data

Insulation; G

Cover Board; G

Fasteners; G

Recycled Content For Insulation; S

SD-06 Test Reports

Flame Spread Rating; G

SD-07 Certificates

Installer Qualifications; G

SD-08 Manufacturer's Instructions

Nails and Fasteners; G

Roof Insulation; G

1.3 SHOP DRAWINGS

Submit insulation board layout and attachment indicating methods of attachment and spacing, transitions, tapered components, thicknesses of materials, and closure and termination conditions. Show locations of ridges, valleys, crickets, interface with, and slope to, roof drains. Base shop drawings on verified field measurements and include verification of existing conditions..

1.4 PRODUCT DATA

Include data for material descriptions, recommendations for product shelf life, requirements for cover board or coatings, and precautions for flammability and toxicity. Include data to verify compatibility of sealants with insulation.

1.5 MANUFACTURER'S INSTRUCTIONS

Include field of roof and perimeter attachment requirements.

Provide a complete description of installation sequencing for each phase of the roofing system. Include weatherproofing procedures.

1.6 QUALITY CONTROL

Provide certification of installer qualifications from the insulation manufacturer confirming the specific installer has the required qualifications for installing the specific roof insulation system(s) indicated.

1.7 FM APPROVAL REQUIREMENTS

Provide fastening patterns in accordance with FM 1-120 for insulation on steel decks.

1.8 FIRE PERFORMANCE REQUIREMENTS

1.8.1 Insulation in Roof Systems

Comply with the requirements of ICC IBC or FM 4450. Roof insulation to have a flame spread rating of 75 or less when tested in accordance with ASTM E84. Additional documentation of compliance with flame spread rating is not required when insulation of the type used for this project as part of the specific roof assembly is listed and labeled as FM Class 1 approved. Only roof assemblies that pass FM 4450 may be used.

1.9 DELIVERY, STORAGE, AND HANDLING

1.9.1 Delivery

Deliver materials to the project site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

- a. Name of manufacturer
- b. Brand designation
- c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification

Deliver materials in sufficient quantity to allow continuity of the work.

1.9.2 Storage and Handling

Store and handle materials in accordance with manufacturer's printed instructions. Protect from damage, exposure to open flame or other ignition sources, wetting, condensation, and moisture absorption. Keep materials wrapped and separated from off-gassing materials (such as drying paints and adhesives). Do not use materials that have visible moisture or biological growth. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment.

1.10 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

1.11 PROTECTION

1.11.1 Completed Work

Avoid traffic on completed work particularly when ambient temperature is above 80 degrees F. Replace crushed or damaged insulation prior to roof surface installation.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Provide the following roof insulation materials. Provide roof insulation

that is compatible with attachment methods for the specified insulation and roof membrane.

- a. Polyisocyanurate Board: Provide in accordance with ASTM C1289 REV A Type II, fibrous felt or glass mat membrane both sides, except minimum compressive strength of 20 pounds per square inch (psi).

2.1.2 Recycled Materials

Provide thermal insulation materials containing recycled content. Unless specified otherwise, the minimum required recycled content for listed materials are:

Polyisocyanurate/polyurethane:	9 percent recovered material
--------------------------------	------------------------------

Provide data identifying percentage of recycled content for insulation.

2.1.3 Insulation Thickness

As necessary to provide the thermal resistance (R-value) indicated. Base calculation on the R-value for aged insulation. For insulation over steel decks, satisfy both specified R-value and minimum thickness for width of rib opening recommended in insulation manufacturer's published literature.

2.1.4 Tapered Roof Insulation for insulation crickets

Tapered roof insulation assembly must be factory tapered to a slope of not less than 1 1/2 inch per foot. Factory fabricate mitered joints from two diagonally cut boards or one board shaped to provide required slopes.

2.2 COVER BOARD

For use as a cover board for adhesive-applied roofing membrane over roof insulation.

2.2.1 Glass Mat Gypsum Roof Board

ASTM C1177/C1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E84, 500 psi, Class A, non-combustible, 1/2 inch thick, 4 by 8 feet board size.

2.3 FASTENERS

Provide flush-driven fasteners through flat round or hexagonal steel or plastic plates. Provide zinc-coated steel plates, flat round not less than 1 3/8 inch diameter, hexagonal not less than 28 gage. Provide high-density plastic plates, molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. Fully recess fastener head into plastic plate after it is driven. Form plates to prevent dishing. Do not use bell or cup shaped plates. Provide fasteners in accordance with insulation manufacturer's recommendations for holding power when driven, or a minimum of 120 pounds each in steel deck, whichever is the higher minimum. Provide fasteners for steel or concrete decks in accordance with FM APP GUIDE (<http://www.approvalguide.com/>) for Class I roof deck construction, and spaced to withstand uplift pressure of 120 pounds per square foot.

2.3.1 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws in accordance with FM 4450 and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure of 120 psf in accordance with FM APP GUIDE.

2.4 WOOD NAILERS

Pressure-preservative treated as specified in Section 06 10 00 ROUGH CARPENTRY. Use for copings, scuppers and curb flanges only.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Ensure surfaces are clean, smooth, and dry prior to application. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The Contractor and roofing manufacturer must inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

- a. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex.

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage from hollow or low spots, perform the following:

- a. Provide wood nailers of the same thickness as the insulation at curbs and roof openings for securing flashing flanges.

3.2 INSULATION INSTALLATION

Apply insulation in two layers with staggered joints when total required thickness of insulation exceeds 1/2 inch. Lay insulation so that continuous longitudinal joints are perpendicular to direction of roofing, and end joints of each course are staggered with those of adjoining courses. When using multiple layers of insulation, provide joints of each succeeding layer that are parallel and offset in both directions with respect to the layer below. Keep insulation 1/2 inch clear of vertical surfaces penetrating and projecting from roof surface. Verify required slopes to each roof drain.

3.2.1 Installation Using Only Mechanical Fasteners

Secure total thickness of insulation with penetrating type fasteners.

3.2.2 Special Precautions for Installation of Foam Insulation

3.2.2.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 1/2 inch glass mat gypsum roof board over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

Install cover board fully adhered to top insulation layer using method and materials as recommended by roofing manufacturer.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with finished roofing specified in 07 54 23 THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING on same day. Phased construction is not permitted. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces is not permitted. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight in accordance with indicated live load limits of roof construction. Protect exposed edges of insulation with cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs must be single ply set in roof cement. Fill all profile voids in cutoffs to prevent trapping moisture below the membrane. Remove cutoffs when work resumes.

3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.4 INSPECTION

Establish and maintain inspection procedures to assure compliance of the installed roof insulation with contract requirements. Remove, replace, correct in an approved manner, any work found not in compliance. Quality control must include, but is not limited to, the following:

- a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.
- b. Verification of certification, listing or label compliance with FM Data Sheets. (
<https://www.fmglobal.com/fmglobalregistration/Downloads.aspx>)
- c. Verification of proper storage and handling of insulation materials before, during, and after installation.
- d. Inspection of mechanical fasteners; type, number, length, and spacing.

- e. Coordination with other materials, cants, sleepers, and nailing strips.
- f. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.
- g. Installation of cutoffs and proper joining of work on subsequent days.
- h. Continuation of complete roofing system installation to cover insulation installed same day.
- i. Verification of required slope to each roof drain.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 27 10.00 10

BUILDING AIR BARRIER SYSTEM

08/19, CHG 1: 02/20

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 REFERENCES
- 1.3 DEFINITIONS
 - 1.3.1 Air Barrier Accessory
 - 1.3.2 Air Barrier Assembly
 - 1.3.3 Air Barrier Component
 - 1.3.4 Air Barrier Envelope
 - 1.3.5 Air Barrier Material
 - 1.3.6 Air Barrier System
 - 1.3.7 Air Leakage Rate
 - 1.3.8 Air Leakage
 - 1.3.9 Air Permeance
 - 1.3.10 Environmental Separator
 - 1.3.11 Vapor Permeance
- 1.4 PREPARATORY PHASE OR PRECONSTRUCTION CONFERENCE
- 1.5 SUBMITTALS
- 1.6 AIR BARRIER ENVELOPE SURFACE AREA AND LEAKAGE REQUIREMENTS
- 1.7 AIR BARRIER INSPECTOR
- 1.8 DESIGN REVIEW

PART 2 PRODUCTS

- 2.1 AIR BARRIER

PART 3 EXECUTION

- 3.1 QUALITY CONTROL
 - 3.1.1 Documentation and Reporting
 - 3.1.2 Quality Control Testing And Inspection
- 3.2 REPAIR AND PROTECTION

-- End of Section Table of Contents --

SECTION 07 27 10.00 10

BUILDING AIR BARRIER SYSTEM

08/19, CHG 1: 02/20

PART 1 GENERAL

1.1 SUMMARY

This Section specifies the construction and quality control of the installation of an air barrier system. Construct the air barrier system indicated, taking responsibility for the means, methods, and workmanship of the installation of the air barrier system. The air barrier must be contiguous and connected across all surfaces of the enclosed air barrier envelope indicated. The maximum leakage requirements of individual air barrier components and materials are specified in the other specification sections covering these items.

This section also defines the maximum allowable leakage of the final air barrier system. The workmanship must be adequate to meet the maximum allowable leakage requirements of this specification. Test the assembled air barrier system to demonstrate that the building envelope is properly sealed and insulated. Passing the air barrier system leakage test and thermography test will result in system acceptance. Conform air barrier system leakage and thermography testing and reporting to the requirements of Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies
----------	--

Containing Combustible Components

1.3 DEFINITIONS

The following terms as they apply to this section:

1.3.1 Air Barrier Accessory

Products designated to maintain air tightness between air barrier materials, air barrier assemblies and air barrier components, to fasten them to the structure of the building, or both (e.g., sealants, tapes, backer rods, transition membranes, fasteners, strapping, primers).

1.3.2 Air Barrier Assembly

The combination of air barrier materials and air barrier accessories that are designated and designed within the environmental separator to act as a continuous barrier to the movement of air through the environmental separator.

1.3.3 Air Barrier Component

Pre-manufactured elements such as windows, doors, dampers and service elements that are installed in the environmental separator.

1.3.4 Air Barrier Envelope

The combination of air barrier assemblies and air barrier components, connected by air barrier accessories that are designed to provide a continuous barrier to the movement of air through an environmental separator. There may be more than one air barrier envelope in a single building. Also known as Air Barrier System.

1.3.5 Air Barrier Material

A building material that is designed, tested and/or produced to provide the primary resistance to airflow through an air barrier assembly of a wall system.

1.3.6 Air Barrier System

Same as AIR BARRIER ENVELOPE.

1.3.7 Air Leakage Rate

The rate of airflow (CFM) driven through a unit surface area (sq.ft.) of an assembly or system by a unit static pressure difference (Pa) across the assembly. (example: 0.25 CFM/sq.ft. @ 75 Pa)

1.3.8 Air Leakage

The total airflow (CFM) driven through the air barrier system by a unit static pressure difference (Pa) across the air barrier envelope. (example: 6500 CFM @ 75 Pa)

1.3.9 Air Permeance

The tested rate of airflow (CFM) through a unit area (sq.ft.) of a material driven by unit static pressure difference (Pa) across the

material (example: 0.004 CFM/sq.ft. @ 75 Pa) as established by ASTM E2178.

1.3.10 Environmental Separator

The parts of a building that separate the controlled interior environment from the uncontrolled exterior environment, or that separate spaces within a building that have dissimilar environments. Also known as the Control Layer.

1.3.11 Vapor Permeance

Vapor permeance is separated into three classes based on the water vapor permeance of a material as tested via ASTM E96/E96M

Class I Vapor Barrier/Retarder 0.1 perm or less

Class II Vapor Barrier/Retarder 0.1 perm to 1.0 perm

Class III Vapor Barrier/Retarder 1.0 perm to 10 perm

1.4 PREPARATORY PHASE OR PRECONSTRUCTION CONFERENCE

Organize pre-construction conferences between the air barrier inspector and the sub-contractors involved in the construction of or penetration of the air barrier system to discuss where the work of each sub-contractor begins and ends, the sequence of installation, and each sub-contractor's responsibility to ensure airtight joints, junctures, penetrations and transitions between materials. Discuss the products, and assemblies of products specified in the different sections to be installed by the different sub-contractors.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Air Barrier System Shop Drawings; G, Manufacturer produced warranted air barrier system

SD-03 Product Data

Air Barrier System Product Data; G

SD-04 Samples

Material Samples For Air Barrier System; G

SD-05 Design Data

Design Data And Calculations For The Air Barrier System; G, Manufacturer produced warranted air barrier system

SD-06 Test Reports

Design Review Report; G

Testing and Inspection; G

SD-07 Certificates

Air Barrier Inspector; G, RO

1.6 AIR BARRIER ENVELOPE SURFACE AREA AND LEAKAGE REQUIREMENTS

The building air barrier systems must meet maximum leakage rate of 0.25 cfm/ sq. ft. The allowable leakage rate and the maximum leakage are at a differential test pressure of 75 Pa.

1.7 AIR BARRIER INSPECTOR

Employ a designated Air Barrier Inspector on this project. The Air Barrier Inspector performs a Design Review, oversees quality control testing specified in these specifications, performs quality control air barrier inspection as specified, interfaces with the designer and product manufacturer's representatives to assure all installation requirements are met, and verifies that the constructed work is in accordance with both the manufacturer's recommendations for products used, the content of this specification and other contract drawings or documents. Qualification for the Air Barrier Inspector are as follows:

- a. Training and certification as an Air Barrier Auditor from the Air Barrier Association of America (ABAA) or other third party air barrier association.
- b. Or, provide documentation in resume format that demonstrates that the individual proposed has the experience, knowledge, skills and abilities to fulfill the above stated duties as the air barrier inspector.
- c. It is acceptable that this individual be employed by the firm who will be performing the building pressurization test or another independent third party entity, provided they meet the above requirements but shall not be a member of the installing contractor or firm.

Provide copies of Air Barrier Inspector qualifications 30 days after Notice to Proceed.

1.8 DESIGN REVIEW

Review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the construction of an effective air barrier system. Provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper air barrier system. Provide copies of the Design Review Report not later than 14 days after approval of the Air Barrier Inspector Qualifications. Submit design data and calculations for the Air Barrier System for a manufacturer produced warranted air barrier system.

PART 2 PRODUCTS

2.1 AIR BARRIER

Provide combined air barrier and vapor retarder system as indicated on the drawings. Provide air barrier system of compatible parts from one or several manufacturers coordinated by the contractor or provide a single warranted system provided by a primary manufacturer. The air barrier system as part of a tested exterior wall assembly must meet the conditions of acceptance as tested in accordance with NFPA 285. Materials used for roof assembly air barrier must conform to the appropriate UL and FM wind and fire requirements for the specified roof assemblies.

If a complete air barrier system from a single manufacturer is utilized, whether warranted or not warranted, the air barrier system must conform to ASTM E2357.

Materials in the following categories as used in the air barrier system or assembly of the exterior wall system are tested and are required to conform to ASTM E2178: Self-adhered sheet membranes, fluid applied membranes, spray polyurethane foam, mechanically fastened commercial building wrap, factory bonded membranes to sheathing, and adhesive backed commercial building wrap and accessory products.

Other materials used as an air barrier such as concrete, glass, wood, metal or gypsum board may or may not conform to ASTM E2178 but are acceptable provided that when integrated into the air barrier system or assemblies that they are not subject to material or environmental induced degradation in their final produced state and once incorporated in the permanent construction.

All materials used must be identifiable through manufacturer testing data and/or literature to be compatible with all the attached or adjoining materials or substrates used in the system.

Provide Air Barrier System Shop Drawings, Material Samples for Air Barrier System and Air Barrier System Product Data.

PART 3 EXECUTION

3.1 QUALITY CONTROL

3.1.1 Documentation and Reporting

Document the entire installation process on daily job site reports. These reports include information on the Installer, substrates, substrate preparation, products used, ambient and substrate temperature, the location of the air barrier installation, the results of the quality control procedures, and testing results.

3.1.2 Quality Control Testing And Inspection

Conduct the following tests and inspections as applicable in the presence of the Contracting Officer during installation of the air barrier system, and submit quality control reports as indicated below.

- a. Provide a Daily Report of Observations with a copy to the Contracting Officer.

- b. Inspect to assure continuity of the air barrier system throughout the building enclosure and that all gaps are covered, the covering is structurally sound, and all penetrations are sealed allowing for no infiltration or exfiltration through the air barrier system.
- c. Inspect to assure structural support of the air barrier system to withstand design air pressures.
- d. Inspect to assure masonry surfaces receiving air barrier materials are smooth, clean, and free of cavities, protrusions and mortar droppings, with mortar joints struck flush or as required by the manufacturer of the air barrier material.
- e. Inspect and test to assure site conditions for application temperature, and dryness of substrates are within guidelines.
- f. Inspect to assure substrate surfaces are properly primed if applicable and in accordance with manufacturer's instructions. Priming must extend at least 2 inches beyond the air barrier material to make it obvious that the primer was applied to the substrate before the air barrier material.
- g. Inspect to assure laps in materials are at least a 2-inch minimum, shingled in the correct direction or mastic applied in accordance with manufacturer's recommendations, and with no fishmouths.
- h. Inspect to assure that a roller has been used to enhance adhesion. Identify any defects such as fishmouths, wrinkles, areas of lost adhesion, and improper curing. Note the intended remedy for the deficiencies.
- i. Measure application thickness of liquid applied materials to assure that manufacturer's specifications for the specific substrate are met.
- j. Inspect to assure that the correct materials are installed for compatibility.
- k. Inspect to assure proper transitions for change in direction and structural support at gaps.
- l. Inspect to assure proper connection between assemblies (membrane and sealants) for cleaning, preparation and priming of surfaces, structural support, integrity and continuity of seal.
- m. Perform adhesion tests for fluid-applied and self-adhered air barrier membranes to assure that the manufacturer's specified adhesion strength properties are met. Determine the bond strength of coatings to substrate in accordance with ASTM D4541.
- n. Provide cohesion tests for spray polyurethane foam (SPF). Perform adhesion tests as follows: Using a coring tool remove a sample and determine the relative adhesion quality of the foam. If the foam is hard to remove and leaves small bits of foam on the substrate it is called cohesive foam failure and is considered the best adhesion. If the foam comes away from the substrate with some force but is clean, it is called a mechanical bond. If it comes away easily from the substrate, the adhesion is poor. Cohesive foam failure and a good mechanical bond are acceptable.

- o. Provide written test reports of all tests performed.

3.2 REPAIR AND PROTECTION

Upon completion of inspection, testing, sample removal and similar services, repair damaged construction and restore substrates, coatings and finishes. Protect construction exposed by or for quality control service activities, and protect repaired construction.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 27 19.01

SELF-ADHERING AIR BARRIERS

05/17, CHG 2: 08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 SUBMITTALS
- 1.4 MISCELLANEOUS REQUIREMENTS
 - 1.4.1 Shop Drawings
 - 1.4.2 Product Data
 - 1.4.3 Mockup
 - 1.4.4 Test Reports
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - 1.5.1 Delivery
 - 1.5.2 Storage
- 1.6 FIELD PEEL ADHESION TEST
- 1.7 AIR BARRIER TESTING
- 1.8 QUALITY ASSURANCE
 - 1.8.1 Qualifications of Manufacturer
 - 1.8.2 Qualifications of Installer
- 1.9 PRECONSTRUCTION MEETING
- 1.10 ENVIRONMENTAL CONDITIONS
 - 1.10.1 Temperature
 - 1.10.2 Exposure to Weather and Ultraviolet Light

PART 2 PRODUCTS

- 2.1 SELF ADHERING AIR BARRIER
 - 2.1.1 Physical Properties
- 2.2 PRIMERS, ADHESIVES, AND MASTICS
- 2.3 SHEET METAL FLASHING
- 2.4 JOINT SEALANTS

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 INSTALLATION
 - 3.3.1 Installation of Self-adhering Air Barrier
- 3.4 FIELD QUALITY CONTROL
 - 3.4.1 Site Inspections and Testing
- 3.5 FIELD PEEL ADHESION TEST
- 3.6 PROTECTION AND CLEANING
 - 3.6.1 Protection
 - 3.6.1.1 Adjacent Surfaces
 - 3.6.1.2 The Air Barrier Assembly
 - 3.6.2 Cleaning

-- End of Section Table of Contents --

SECTION 07 27 19.01

SELF-ADHERING AIR BARRIERS
05/17, CHG 2: 08/20

PART 1 GENERAL

1.1 REFERENCES

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

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation

Accreditation

ABAA QAP

Quality Assurance Program

ASTM INTERNATIONAL (ASTM)

ASTM D146/D146M

(2004; E 2012; R 2012) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics for Roofing and Waterproofing

ASTM D412

(2016) Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension

ASTM D570

(1998; E 2010; R 2010) Standard Test Method for Water Absorption of Plastics

ASTM D903

(1998; R 2017) Standard Test Method for Peel or Stripping Strength of Adhesive Bonds

ASTM D1876

(2008; R 2015; E 2015) Standard Test Method for Peel Resistance of Adhesives (T-Peel Test)

ASTM D4263

(1983; R 2018) Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method

ASTM D4541

(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM E84

(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E96/E96M

(2016) Standard Test Methods for Water Vapor Transmission of Materials

ASTM E154/E154M

(2008a; R 2013; E 2013) Water Vapor Retarders Used in Contact with Earth Under

Concrete Slabs, on Walls, or as Ground Cover

ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E331	(2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E2178	(2021a) Standard Test Method for Air Permeance of Building Materials
ASTM E2357	(2017) Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components
----------	--

1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS and other building enclosure sections to provide a complete building air barrier system. Submit all materials, components, and assemblies of the air barrier system together as one complete submittal package.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Qualifications of Manufacturer; G

Qualifications of Installer; G

SD-02 Shop Drawings

Self-adhering Air Barrier; G

SD-03 Product Data

Self-adhering Air Barrier; G

Primers, Adhesives, and Mastics; G

Safety Data Sheets; G

SD-06 Test Reports

Field Peel Adhesion Test; G

Flame Propagation of Wall Assemblies; G

Flame Spread and Smoke Developed Index Ratings; G

Site Inspections and Testing; G

SD-07 Certificates

Self-adhering Air Barrier; G

SD-08 Manufacturer's Instructions

Self-adhering Air Barrier; G

Primers, Adhesives, and Mastics; G

1.4 MISCELLANEOUS REQUIREMENTS

For self-adhering air barrier provide the following:

1.4.1 Shop Drawings

Submit self-adhering air barrier shop drawings showing locations and extent of air barrier assemblies and details of all typical conditions, intersections with other building enclosure assemblies and materials, and membrane counterflashings. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the self-adhered barrier without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

1.4.2 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.

1.4.3 Mockup

Provide a mockup of the self-adhering air barrier system specified. Apply product in an area designated by the Contracting Officer. Apply an area of not less than 54 square feet. Include all components specified as representative of the complete system. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be covered including window or door

openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

1.4.4 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 propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports for flame spread and smoke developed index ratings of barrier system materials tested in accordance with ASTM E84.

1.5 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 and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of containerized materials. Store and handle to protect from damage.

1.5.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Protect stored materials from direct sunlight. Keep materials sealed and separated from absorptive materials, such as wood and insulation.

1.6 FIELD PEEL ADHESION TEST

Perform a field peel-adhesion test on the construction mockup. Test the self-adhering air barrier for adhesion in accordance with ASTM D4541 using a Type II pull tester except use a disk that is 4 inches in diameter and cut through the membrane to separate the material attached to the dish from the surrounding material. Perform test after curing period in accordance with manufacturer's written recommendations. Record mode of failure and area which failed in accordance with ASTM D4541. Compare adhesion values with the manufacturer's established minimum values for the particular combination of material and substrate. Indicate on the inspection report whether the manufacturer's requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product and substrate combination, the inspector must record actual values.

1.7 AIR BARRIER TESTING

Perform air barrier testing in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

1.8 QUALITY ASSURANCE

1.8.1 Qualifications of Manufacturer

Submit documentation verifying that the manufacturer of the self-adhering air barrier is currently accredited by Air Barrier Association of America (

ABAA Accreditation <https://www.airbarrier.org/>).

1.8.2 Qualifications of Installer

Submit documentation verifying that installers of the self-adhering air barrier are currently certified in accordance with the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>).

1.9 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting a minimum of two weeks prior to commencing work specified in this Section. Agenda must include, at a minimum, construction and testing of mockup, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance is required by representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the air barrier system.

1.10 ENVIRONMENTAL CONDITIONS

1.10.1 Temperature

Install air barrier within the range of ambient and substrate temperatures as recommended in writing by the air barrier manufacturer. Verify that the surface to receive self-adhering air barrier is dry for a minimum of 48 hours prior to the installation of the barrier. Do not apply air barrier to damp or wet substrates. Do not apply during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent.

1.10.2 Exposure to Weather and Ultraviolet Light

Protect air barrier products from direct exposure to rain, snow, sunlight, mist, and other extreme weather conditions. Replace, at no additional cost to the government, barrier products that have been exposed to ultraviolet (sun)light longer than allowed by manufacturer's written requirements.

PART 2 PRODUCTS

2.1 SELF ADHERING AIR BARRIER

Provide minimum 0.040 inch thick self-adhering, vapor retarding, air barrier membrane consisting of a cross-laminated high density polyethylene (HDPE) film, fully coated with rubberized asphalt adhesive. Provide membrane in rolls of various widths interleaved with disposable silicone release paper. Self-adhering air barrier must exhibit no visible water leakage when tested in accordance with ASTM E331 and must perform as a liquid water drainage plane flashed to discharge to the exterior any incidental condensation or water penetration. Use regular or low temperature formulation depending on site conditions, within temperature ranges specified by manufacturer.

2.1.1 Physical Properties

- a. Air Permeance (ASTM E2178): In accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM.

- b. Air Leakage (ASTM E2357, ASTM E283): In accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.
- c. Tensile Strength (ASTM D412 die C modified): Not less than 400 psi.
- d. Tensile Elongation (ASTM D412 die C modified): Not less than 200 percent.
- e. Puncture Resistance (ASTM E154/E154M): Not less than 40 lbs.
- f. Pliability (ASTM D146/D146M): Unaffected at minus 25 degrees F, 0.063 inch mandrel.
- g. Lap Adhesion (ASTM D1876 modified): Not less than 4.0 lbs per inch.
- h. Peel Adhesion (ASTM D903): Not less than 5.0 lbs per inch.
- i. Water Vapor Permeance (Vapor Permeable Air Barrier) (ASTM E96/E96M, desiccant method B): As indicated.
- j. Water Absorption (ASTM D570): Not to exceed 0.12 percent by weight.
- k. Flame propagation of wall assemblies (NFPA 285): Pass
- l. Surface Burning Characteristics (ASTM E84):
 - (1) Flame Spread Index Rating not higher than 75.
 - (2) Smoke Developed Index Rating not higher than 150.

2.2 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics and other accessory materials as recommended in writing by the manufacturer of the self-adhering air barrier for adequate bonding to each type of substrate.

2.3 SHEET METAL FLASHING

Provide as specified in Section 07 60 00 FLASHING AND SHEET METAL.

2.4 JOINT SEALANTS

Provide as specified in Section 07 92 00 JOINT SEALANTS. Verify compatibility with adjacent products that are or will be in contact with one another.

PART 3 EXECUTION

3.1 EXAMINATION

Before installing air barrier, examine substrates, areas, and conditions under which air barrier assemblies will be applied, with Installer present, for compliance with requirements. Ensure the following conditions are met:

- a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants.

- b. Concrete surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions.
- c. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263 and take suitable measures until substrate passes moisture test.
- d. Verify sealants used in sheathing are compatible with membrane proposed for use. Perform field peel adhesion test on materials to which sealants are adhered.

3.2 PREPARATION

Clean, prepare, and treat substrate in accordance with manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for air barrier application.

- a. Prime masonry and concrete substrates with conditioning primer.
- b. Prime gypsum sheathing an adequate number of coats to achieve required bond, with adequate drying time between coats.
- c. Prime wood, metal, and painted substrates with primer.
- d. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through air barrier and at protrusions.

3.3 INSTALLATION

3.3.1 Installation of Self-adhering Air Barrier

Install materials in accordance with manufacturer's recommendations and the following:

- a. Apply primer at rate recommended by manufacturer prior to membrane installation. Allow primer to dry completely before membrane application. Apply as many coats as necessary for proper adhesion.
- b. When membrane is properly positioned, press into place and roll membrane with roller immediately after placement.
- c. Apply membrane sheets to shed water naturally without interception by a sheet edge, unless that edge is sealed with permanently flexible termination mastic.
- d. Position subsequent sheets of membrane applied above so that membrane overlaps the membrane sheet below by a minimum of 2-1/2 inches, unless greater overlap is recommended by manufacturer. Roll into place with roller.
- e. Make all side laps a minimum of 2-1/2 inches and all end laps a minimum of 5 inches, unless greater overlap is recommended by manufacturer. Roll seams with roller.
- f. Roll membrane to adhere to substrate. Cover corners and joints with two layers of reinforcement by first applying a 12 inch width of membrane centered along the axis. Flash drains and projections with a

second ply of membrane for a distance of 6 inches from the drain or projection.

- g. Seal around all penetrations through the air barrier resulting from pipes, vents, conduit, electrical fixtures, structural members, or other construction passing through it. Seal with termination mastic, extruded silicone sealant, membrane counterflashing or other sealing methods in accordance with manufacturer's written recommendations.
- h. Continuously connect the air barrier between walls, roof, floor and below grade assemblies to form a continuous integrated air barrier system around the entire building enclosure. Extend the air barrier membrane into rough openings such as doors, windows, louvers, and other exterior penetrations. Seal edges of barrier at junctures with rough openings.
- i. At changes in substrate plane, provide transition material (e.g. bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
- j. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Continuously support membrane with substrate.
- k. At deflection and control joints, provide backup for the membrane to accommodate anticipated movement.
- l. At expansion and seismic joints provide transition to the joint assemblies.
- m. Apply a bead or trowel coat of mastic along membrane seams at reverse lapped seams, rough cuts, and as recommended by the manufacturer.
- n. At end of each working day, seal top edge of membrane to substrate with termination mastic.
- o. Do not allow materials to come in contact with chemically incompatible materials.
- p. Counterflash upper edge of thru-wall flashing and air barrier. Counter flashing and thru-wall flashing are specified in Section 07 60 00 FLASHING AND SHEET METAL.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Inspections and Testing

Provide site inspections and testing in accordance with ABAA protocol to verify conformance with the manufacturer's instructions, the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>), Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM,, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and this section.

- a. Conduct inspections and testing at 5, 50, and 95 percent completion of this scope of work. Forward written site inspections and testing reports to the Contracting Officer within five working days of the inspection and test being performed.

- b. If inspections reveal any defects, promptly remove and replace defective work at no additional expense to the Government.

3.5 FIELD PEEL ADHESION TEST

Conduct in accordance with test protocol indicated in Part 1, paragraph FIELD PEEL ADHESION TEST.

3.6 PROTECTION AND CLEANING

3.6.1 Protection

3.6.1.1 Adjacent Surfaces

Protect exposed adjacent surfaces that could be damaged by primers and adhesives associated with air barrier membrane. Provide protection during application and the remainder of construction in accordance with manufacturer's written instructions.

3.6.1.2 The Air Barrier Assembly

Protect finished portions of the air barrier assembly from damage during ongoing application and throughout the remainder of the construction period in accordance with manufacturer's written instructions. Coordinate timing of installation of materials that will cover the air barrier membrane to ensure the exposure period does not exceed that recommended by the air barrier manufacturer's written installation instructions. Remove and replace, at no additional cost to the government, membrane products that exceed the manufacturer's allowed exposure limits.

3.6.2 Cleaning

Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction and as acceptable to the primary material manufacturer.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIERS

05/17, CHG 2: 08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 SUBMITTALS
- 1.4 CERTIFICATIONS
 - 1.4.1 Indoor Air Quality Certification
- 1.5 MISCELLANEOUS REQUIREMENTS
 - 1.5.1 Shop Drawings
 - 1.5.2 Product Data
 - 1.5.3 Mockup
 - 1.5.4 Test Reports
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.6.1 Delivery
 - 1.6.2 Storage
- 1.7 CAPILLARY MOISTURE TEST
- 1.8 FIELD PEEL ADHESION TEST
- 1.9 AIR BARRIER TESTING
- 1.10 QUALITY ASSURANCE
 - 1.10.1 Qualifications of Manufacturer
 - 1.10.2 Qualifications of Installer
- 1.11 PRECONSTRUCTION MEETING
- 1.12 ENVIRONMENTAL CONDITIONS
 - 1.12.1 Temperature
 - 1.12.2 Exposure to Weather

PART 2 PRODUCTS

- 2.1 FLUID-APPLIED MEMBRANE AIR BARRIER
 - 2.1.1 Physical Properties
- 2.2 PRIMERS, ADHESIVES, AND MASTICS
- 2.3 TRANSITION MEMBRANE
- 2.4 SHEET METAL FLASHING
- 2.5 JOINT SEALANTS
- 2.6 REINFORCEMENT

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 PREPARATION
- 3.3 INSTALLATION
 - 3.3.1 Installation of Transition Membrane
 - 3.3.2 Installation of Flashing
 - 3.3.3 Installation of Fluid-Applied Membrane Air Barrier
 - 3.3.4 Installation of Reinforcement
- 3.4 FIELD QUALITY CONTROL

- 3.4.1 Site Inspections and Testing
- 3.5 PROTECTION AND CLEANING
 - 3.5.1 Protection
 - 3.5.2 Cleaning of Adjacent Surfaces
- 3.6 CLEANUP OF SPILLS

-- End of Section Table of Contents --

SECTION 07 27 26

FLUID-APPLIED MEMBRANE AIR BARRIERS
05/17, CHG 2: 08/20

PART 1 GENERAL

1.1 REFERENCES

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

AIR BARRIER ASSOCIATION OF AMERICA (ABAA)

ABAA Accreditation

Accreditation

ABAA QAP

Quality Assurance Program

ASTM INTERNATIONAL (ASTM)

ASTM C836/C836M

(2015) High Solids Content, Cold
 Liquid-Applied Elastomeric Waterproofing
 Membrane for Use With Separate Wearing
 Course

ASTM D412

(2016) Standard Test Methods for
 Vulcanized Rubber and Thermoplastic
 Elastomers - Tension

ASTM D4263

(1983; R 2018) Standard Test Method for
 Indicating Moisture in Concrete by the
 Plastic Sheet Method

ASTM D4541

(2017) Standard Test Method for Pull-Off
 Strength of Coatings Using Portable
 Adhesion Testers

ASTM D5590

(2000; R 2010; E 2012) Standard Test
 Method for Determining the Resistance of
 Paint Films and Related Coatings to Fungal
 Defacement by Accelerated Four-Week Agar
 Plate Assay

ASTM E84

(2020) Standard Test Method for Surface
 Burning Characteristics of Building
 Materials

ASTM E96/E96M

(2016) Standard Test Methods for Water
 Vapor Transmission of Materials

ASTM E283

(2019) Standard Test Method for
 Determining the Rate of Air Leakage
 Through Exterior Windows, Curtain Walls,
 and Doors Under Specified Pressure
 Differences Across the Specimen

ASTM E331 (2000; R 2016) Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

ASTM E2178 (2021a) Standard Test Method for Air Permeance of Building Materials

ASTM E2357 (2017) Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285 (2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

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

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 RELATED REQUIREMENTS

Coordinate the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and other building enclosure sections to provide a complete building air barrier system. Submit all materials, components and assemblies of the air barrier system together as one complete submittal package.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Qualifications of Manufacturer; G

Qualifications of Installer; G

SD-02 Shop Drawings

Fluid-Applied Membrane Air Barrier; G

SD-03 Product Data

Fluid-Applied Membrane Air Barrier; G

Transition Membrane; G

Primers, Adhesives, and Mastics; G

Reinforcement; G

Safety Data Sheets; G

SD-04 Samples

Fluid-Applied Membrane Air Barrier Mockup; G

SD-06 Test Reports

Capillary Moisture Test; G

Field Peel Adhesion Test; G

Flame Propagation of Wall Assemblies; G

Flame Spread and Smoke Developed Index Ratings; G

Site Inspections Reports; G

SD-07 Certificates

Fluid-Applied Membrane Air Barrier; G

Transition Membrane; G

Indoor Air Quality for Fluid-Applied Air Barrier; S

Indoor Air Quality for Primer and Mastic; S

Indoor Air Quality for Adhesive and Sealant; S

SD-08 Manufacturer's Instructions

Fluid-Applied Membrane Air Barrier; G

Transition Membrane; G

Primers, Adhesives, and Mastics; G

1.4 CERTIFICATIONS

1.4.1 Indoor Air Quality Certification

Submit required indoor air quality certifications in one submittal package.

Provide fluid-applied air barrier, primer, and mastic certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of Green Seal GS-11, California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings, or SCAQMD Rule 1113. Submit product data for indoor air quality for fluid-applied air barrier and indoor air quality for primer and mastic.

Provide adhesive and sealant certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for adhesive and sealant.

1.5 MISCELLANEOUS REQUIREMENTS

For fluid-applied membrane air barriers provide the following:

1.5.1 Shop Drawings

Submit fluid-applied membrane air barrier shop drawings showing locations and extent of barrier assemblies, transition membranes, details of all typical conditions, intersections with other envelope assemblies and materials, and membrane counterflashings. Show details for bridging of gaps in construction, treatment of inside and outside corners, expansion joints, methods of attachment of materials covering the self-adhered barrier without compromising the barrier. Indicate how miscellaneous penetrations such as conduit, pipes, electric boxes, brick ties, and similar items will be sealed.

1.5.2 Product Data

Submit manufacturer's technical data indicating compliance with performance and environmental requirements, manufacturer's printed instructions for evaluating, preparing, and treating substrates, temperature and other limitations of installation conditions, safety requirements for installation, and Safety Data Sheets. Indicate flame and smoke spread ratings for all products.

1.5.3 Mockup

Provide a mockup of the fluid-applied membrane air barrier. Apply product in an area designated by the Contracting Officer. Apply an area of not less than 54 square feet. Include all components specified as representative of the complete system. Notify the Contracting Officer a minimum of 48 hours prior to the test application. Select a test area representative of conditions to be covered including window or door openings, wall to ceiling transitions, flashings, and penetrations, as applicable.

1.5.4 Test Reports

Submit test reports indicating that capillary moisture tests and field peel adhesion tests on all substrate materials have been performed and the changes made, if required, in order to achieve successful and lasting adhesion. Submit test reports for flame propagation of wall assemblies tested in accordance with NFPA 285. Submit test reports for flame spread and smoke developed index ratings of barrier materials tested in accordance with ASTM E84.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver and store materials in sufficient quantity to allow for uninterrupted flow of work. Inspect materials delivered to the site for damage and store out of weather. Deliver materials to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand designation, description of contents, and shelf life of containerized materials. Store and handle to protect from damage.

1.6.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling. Protect stored materials from direct sunlight.

1.7 CAPILLARY MOISTURE TEST

Perform a capillary moisture test by plastic sheet method in accordance with ASTM D4263 on the construction mockup and substrate materials. Perform test after curing period as recommended by the air barrier manufacturer. Record mode of failure and area which failed in accordance with ASTM D4263. Once the air barrier material manufacturer has established a minimum adhesion or moisture level for the product on the particular substrate, indicate on the inspection report whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion or moisture value for their product and substrate combination, the inspector must record actual values.

1.8 FIELD PEEL ADHESION TEST

Perform a field peel adhesion test on a construction mockup. Test the applied product for adhesion in accordance with manufacturer's recommendations. Perform test after curing period recommended by the manufacturer. Record mode of failure and area which failed in accordance with ASTM D4541. When the manufacturer has established a minimum adhesion level for the product on the particular substrate, the inspection report must indicate whether this requirement has been met. Where the manufacturer has not declared a minimum adhesion value for their product/substrate combination, the inspector must record actual values.

1.9 AIR BARRIER TESTING

Perform air barrier testing in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.

1.10 QUALITY ASSURANCE

1.10.1 Qualifications of Manufacturer

Submit documentation verifying that manufacturer of fluid-applied membrane air barrier is currently accredited by the Air Barrier Association of America (ABAA Accreditation <https://www.airbarrier.org/>).

1.10.2 Qualifications of Installer

Submit documentation verifying that installers of the fluid-applied membrane air barrier are currently certified in accordance with the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>).

1.11 PRECONSTRUCTION MEETING

Conduct a preconstruction meeting a minimum of two weeks prior to commencing work specified in this Section. Agenda must include, at a minimum, construction and testing of construction mock up, sequence of construction, coordination with substrate preparation, materials approved for use, compatibility of materials, coordination with installation of adjacent and covering materials, and details of construction. Attendance is required by representatives of related trades including covering materials, substrate materials, adjacent materials, and materials and components of the fluid-applied membrane air barrier.

1.12 ENVIRONMENTAL CONDITIONS

1.12.1 Temperature

Install fluid-applied membrane air barrier within the range of ambient and substrate temperatures as recommended in writing by the fluid-applied membrane air barrier manufacturer. Do not apply fluid-applied membrane air barrier to a damp or wet substrate. Do not apply during inclement weather or when ice, frost, surface moisture, or visible dampness is present on surfaces to be covered, or when precipitation is imminent.

1.12.2 Exposure to Weather

Protect fluid-applied membrane air barrier products from direct exposure to rain, snow, sunlight, mist, and other extreme weather conditions. Replace, at no additional cost to the government, barrier products that have been exposed to ultraviolet (sun)light longer than allowed by manufacturer's written requirements.

PART 2 PRODUCTS

2.1 FLUID-APPLIED MEMBRANE AIR BARRIER

Provide a fluid-applied, vapor retarding, air barrier. This barrier must exhibit no visible water leakage when tested in accordance with ASTM E331 and must perform as a liquid water drainage plane with thru-wall flashing to discharge incidental condensation and water penetration to the exterior of the building enclosure. Provide products suitable for use within temperature ranges specified by manufacturer for the location of the project.

2.1.1 Physical Properties

- a. Air Permeance (ASTM E2178): in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM
- b. Air Leakage (ASTM E2357, ASTM E283): in accordance with Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS.
- c. Water Vapor Permeance (Vapor Permeable Membrane) (ASTM E96/E96M,

desiccant method A): as indicated.

- d. Tensile Strength (ASTM D412): Not less than 138 psi.
- e. Elongation (ASTM D412): Not less than 300 percent.
- f. Low temperature Flexibility and Crack Bridging (ASTM C836/C836M):
Pass at minus 15 degrees F.
- g. Solids by Volume: minimum 50 percent.
- h. Flame propagation of wall assemblies (NFPA 285): Pass
- i. Surface Burning Characteristics (ASTM E84):
 - (1) Flame Spread Index Rating not higher than 75.
 - (2) Smoke Developed Index Rating not higher than 150.
- j. Resistance to Mold, Mildew and Fungal Growth (ASTM D5590): 0, No growth.

2.2 PRIMERS, ADHESIVES, AND MASTICS

Provide primers, adhesives, mastics, sealants and other accessories as recommended by manufacturer of fluid-applied membrane air barrier for a complete installation.

2.3 TRANSITION MEMBRANE

Provide as specified in Section 07 27 19.01 SELF-ADHERING AIR BARRIERS.

2.4 SHEET METAL FLASHING

Provide as specified in Section 07 60 00 FLASHING AND SHEET METAL.

2.5 JOINT SEALANTS

Provide as specified in Section 07 92 00 JOINT SEALANTS.

2.6 REINFORCEMENT

Provide fiberglass mesh tape, or fluid-applied air barrier manufacturer's approved comparable equal product, reinforcement at seams, edges, projections and penetrations. Reinforce all joints exceeding 1/4 inch with fiberglass mesh.

PART 3 EXECUTION

3.1 EXAMINATION

Before installing fluid-applied membrane air barrier, examine substrates, areas, and conditions under which fluid-applied membrane air barrier assemblies will be applied, with installer present, for compliance with requirements. Ensure the following conditions are met:

- a. Surfaces are sound, dry, even, and free of oil, grease, dirt, excess mortar or other contaminants detrimental to the adhesion of the membranes.

- b. Concrete and masonry surfaces are cured and dry, smooth without large voids, spalled areas or sharp protrusions. Do not proceed with installation until after minimum concrete curing period recommended by fluid-applied membrane air barrier manufacturer.
- c. Fill voids, gaps and spalled areas in substrate to provide an even plane. Strike masonry joints full flush.
- d. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263 and take suitable measures until substrate passes moisture test.
- e. Verify sealants used in substrates, and in joints between substrates, are compatible with fluid-applied membrane air barrier.

3.2 PREPARATION

Clean, prepare, and treat substrate in accordance with manufacturer's written instructions. Ensure clean, dust-free, and dry substrate for fluid-applied membrane air barrier application.

- a. Remove dust, dirt and other contaminants from joints and cracks before coating surfaces.
- b. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through fluid-applied membrane air barrier.
- c. At changes in substrate plane, provide transition material (bead of sealant, mastic, extruded silicone sealant, membrane counterflashing or other material recommended by manufacturer) under transition membrane to eliminate all sharp 90 degree inside corners and to make a smooth transition from one plane to another.
- d. Provide mechanically fastened non-corrosive metal sheet to span gaps in substrate plane and to make a smooth transition from one plane to the other. Continuously support membrane with substrate.
- e. For exterior sheathing substrates, ensure that exterior sheathing is stabilized, with corners and edges fastened with appropriate screws. Treat all joints in accordance with the air barrier manufacturer's instructions prior to application of air barrier material. Allow sufficient time for joint treatments to fully cure before application of transition membranes and fluid-applied membrane air barrier.
- f. For concrete and masonry substrates, fill all voids and holes, particularly in mortar joints, with non-shrinking grout.
- g. Mask off and cover adjacent surfaces to protect from spillage and overspray.

3.3 INSTALLATION

3.3.1 Installation of Transition Membrane

Install transition membrane materials in accordance with the details on the drawings, Section 07 27 19.01 SELF-ADHERING AIR BARRIERS, and the

following:

- a. Install transition membrane at all required locations prior to installation of the fluid-applied membrane air barrier.
- b. Verify transition membrane is fully adhered to substrate and that its surface is clean, dry and wrinkle free prior to installation of the fluid-applied membrane air barrier.
- c. Verify transition membrane completely covers all transition areas and will provide continuity of the finished fluid-applied membrane air barrier without gaps or cracks.

3.3.2 Installation of Flashing

Counterflash upper edge of thru-wall flashing and fluid-applied air barrier. Counter flashing and thru-wall flashing are specified in Section 07 60 00 FLASHING AND SHEET METAL.

3.3.3 Installation of Fluid-Applied Membrane Air Barrier

Install materials in accordance with manufacturer's recommendations and the following:

- a. Apply fluid-applied membrane air barrier in single or dual coat application by spray or roller. Apply fluid-applied membrane air barrier within manufacturer's recommended temperature range for application.
- b. Apply fluid-applied membrane air barrier in manner and at rate recommended by manufacturer to yield a wet film thickness of 19 mils.
- c. Apply fluid-applied membrane air barrier around all penetrations ensuring a complete and continuous air barrier. Lap fluid-applied membrane air barrier a minimum of 3 inch over transition membrane to seal leading edge.
- d. Seal membrane terminations, heads of mechanical fasteners, masonry tie fasteners, around penetrations, HVAC assemblies, plumbing and electrical assemblies, doors, windows, louvers, and other assemblies penetrating the fluid-applied membrane air barrier with a termination sealant recommended by the fluid-applied membrane air barrier manufacturer.
- e. Notify the Contracting Officer and Testing Agency upon completion of fluid-applied membrane air barrier installation. Air barrier materials and assemblies must remain exposed until tested and inspected by the ABAA.
- f. Do not allow materials to come in contact with chemically incompatible materials.

3.3.4 Installation of Reinforcement

Install reinforcement at projections, corners, joints, and penetrations where applicable.

3.4 FIELD QUALITY CONTROL

3.4.1 Site Inspections and Testing

Provide site inspections and testing in accordance with ABAA protocol to verify conformance with the manufacturer's instructions, the ABAA QAP Quality Assurance Program (<https://www.airbarrier.org/qap/>), Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS, and this section.

- a. Conduct inspections and testing at 5, 50, and 95 percent completion of this scope of work. Forward written inspection reports to the Contracting Officer within five working days of the inspection and test being performed.
- b. If the inspections reveal any defects, promptly remove and replace defective work at no additional expense to the Government.

3.5 PROTECTION AND CLEANING

3.5.1 Protection

Protect fluid-applied membrane air barrier assemblies from damage during application and remainder of construction in accordance with manufacturer's written instructions.

Coordinate installation, testing, and inspection procedures to ensure exposure period does not exceed that recommended by the product manufacturer. Remove and replace, at no additional cost to the government, membrane products that exceed manufacturer's allowed exposure limits.

3.5.2 Cleaning of Adjacent Surfaces

Clean excess product from adjacent construction using cleaning agents and procedures as recommended in writing by the manufacturer of each type of affected construction and as acceptable to same.

3.6 CLEANUP OF SPILLS

Conduct cleanup of uncured product spillage in accordance with manufacturer's written safe handling instructions.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 54 23

THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING

05/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUMMARY
- 1.3 ASSEMBLY REQUIREMENTS
 - 1.3.1 Assembly Rating
 - 1.3.2 Fire Resistance
 - 1.3.3 Wind Uplift Resistance
 - 1.3.4 Solar Reflectance Index (SRI)
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Qualification of Manufacturer
 - 1.5.2 Qualifications of Applicator
 - 1.5.3 Qualification of Engineer of Record
 - 1.5.4 Conformance and Compatibility
 - 1.5.5 Preroofing Conference
- 1.6 DETAIL DRAWINGS
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - 1.7.1 Delivery
 - 1.7.2 Storage
 - 1.7.3 Handling
- 1.8 ENVIRONMENTAL REQUIREMENTS
- 1.9 SEQUENCING
- 1.10 WARRANTY
 - 1.10.1 Roof Membrane Manufacturer Warranty
 - 1.10.2 Roofing System Installer Warranty
 - 1.10.3 Continuance of Warranty

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 TPO Roof Membrane
 - 2.1.2 Energy Star
 - 2.1.3 Energy Performance
 - 2.1.4 Bonding Adhesive
 - 2.1.5 Water Cutoff Mastic/Water Block
 - 2.1.6 Membrane Flashing
 - 2.1.7 Membrane Fasteners and Plates
 - 2.1.7.1 Stress Plates, Bar or Rail for Fasteners
 - 2.1.7.2 Auxiliary Fasteners
 - 2.1.8 Pre-manufactured Accessories
 - 2.1.9 TPO Walk Tread
 - 2.1.10 Roof Insulation
 - 2.1.11 Wood Products
- 2.2 Reinforced, Thermoplastic-Polyolefin (TPO) Membrane
- 2.3 Horizontal Lifeline Fall Protection System (Delegated Design)

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 APPLICATION METHOD
 - 3.2.1 Special Precautions
 - 3.2.2 TPO Roofing Membrane
 - 3.2.2.1 Nailing
 - 3.2.2.2 Flashing
 - 3.2.2.3 Cutoffs
 - 3.2.2.4 Walkways
 - 3.2.3 Adhered Membrane Application
 - 3.2.4 Perimeter Attachment
 - 3.2.5 Securement at Base Tie-In Conditions
 - 3.2.6 Pre-fabricated Curbs
 - 3.2.6.1 Set-On Accessories
 - 3.2.7 Roof Walkways
- 3.3 FLASHINGS
 - 3.3.1 General
 - 3.3.2 Membrane Flashing
 - 3.3.2.1 Installation
 - 3.3.2.2 Sealing
- 3.4 PROTECTION FROM BEARING SUPPORT
- 3.5 CORRECTION OF DEFICIENCIES
- 3.6 PROTECTION OF APPLIED ROOFING
 - 3.6.1 Water Cutoffs
 - 3.6.2 Temporary Flashing for Permanent Roofing
 - 3.6.3 Temporary Walkways, Runways, and Platforms
- 3.7 REGISTERED ROOF OBSERVER
 - 3.7.1 RRO Communication with the Government
- 3.8 FIELD QUALITY CONTROL
 - 3.8.1 Construction Monitoring
 - 3.8.2 Manufacturer's Inspection
- 3.9 CLEAN UP
- 3.10 INSTRUCTIONS TO GOVERNMENT PERSONNEL
- 3.11 ROOF DRAIN TEST

-- End of Section Table of Contents --

SECTION 07 54 23
THERMOPLASTIC-POLYOLEFIN (TPO) ROOFING
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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI ES-1 (2003) Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2017) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.24 (2014) Roofing - Safety Requirements of Low-Sloped Roofs

ASTM INTERNATIONAL (ASTM)

ASTM D4434/D4434M (2015) Standard Specification for Poly(Vinyl Chloride) Sheet Roofing

ASTM D6878/D6878M (2017) Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing

ASTM E108 (2011) Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470 (2016) Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 3619 (2004) Quality Control Guidelines for

Application of Polymer-modified Bitumen
Roofing

NRCA 3740 (2005) The NRCA Waterproofing Manual

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star (1992; R 2006) Energy Star Energy
Efficiency Labeling System (FEMP)

UNDERWRITERS LABORATORIES (UL)

UL 790 (2004; Reprint Jul 2014) Standard Test
Methods for Fire Tests of Roof Coverings

1.2 SUMMARY

Adhered thermoplastic-polyolefin (TPO) roof membrane system applied over insulation.

1.3 ASSEMBLY REQUIREMENTS

Provide roofing membrane sheet widths consistent with membrane attachment methods and wind uplift requirements, and as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Provide membrane which is free of defects and foreign material. Coordinate flashing work to permit continuous roof-surfacing operations. Install insulation and weatherproofed planned sections on the same day.

1.3.1 Assembly Rating

Provide FM GLOBAL VSH rated roofing assembly for hail damage.

1.3.2 Fire Resistance

Complete roof system assembly:

- a. Class A rated in accordance with ASTM E108, FM 4470, or UL 790; and
- b. Be listed as Class I roof deck construction in FM APP GUIDE.

FM or UL approved components of the roof covering assembly must bear the appropriate FM or UL label.

1.3.3 Wind Uplift Resistance

Provide a complete roof system assembly that is rated and installed to resist wind loads calculated in accordance with ASCE 7 and validated by uplift resistance testing in accordance with Factory Mutual (FM) test procedures. Do not install non-rated systems, except as approved by the Contracting Officer. Submit Engineering calculations, signed, sealed, and dated by a Registered Engineer validating the wind resistance per ASCE 7, and ANSI/SPRI ES-1 of non-rated roof system. Base wind uplift measurements on a design wind speed of as indicated on the drawings and in accordance with ASCE 7 and other applicable building code requirements.

1.3.4 Solar Reflectance Index (SRI)

SRI measures the roof's ability to reject solar heat, defined such that a standard black (reflectance 0.05, emittance 0.90) is 0 and a standard white (reflectance 0.80, emittance 0.90) is 100. Use roofing materials having minimum appropriate SRI for more than 75 percent of roof surface (low slope (less than 2:12) SRI greater than 78; high slope (greater than 2:12) SRI greater than 29).

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. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

Roof Plan; G

SD-03 Product Data

TPO Roofing Membrane; G

Recycled Content for TPO; S

Energy Star Label for roof membrane; S

Heat Island Reduction; S

Bonding Adhesive

Flashing

Membrane Fasteners and Plates

Roof Insulation

Recycled Content for Insulation; S

Pre-Manufactured Accessories

Water Cutoffs

Information Card

SD-05 Design Data

Wind Uplift Resistance; G

Fall Restraint System; G

SD-07 Certificates

Qualification of Manufacturer

Qualifications of Applicator

Qualification of Engineer of Record

Wind Uplift Resistance

Fire Resistance classification

Minimum Polymer Thickness

Sample Warranty; G

SD-08 Manufacturer's Instructions

Application Method; G

Membrane Flashing; G

Perimeter Attachment

Auxiliary Fasteners

Pre-Manufactured Accessories

Cold Weather; G

SD-11 Closeout Submittals

Warranty; G

Information Card; G

Instructions to Government Personnel; G

1.5 QUALITY ASSURANCE

1.5.1 Qualification of Manufacturer

Thermoplastic polyolefin sheet roofing system manufacturer must have a minimum of 10 years experience in manufacturing TPO roofing products.

1.5.2 Qualifications of Applicator

Roofing system applicator must be approved, authorized, or licensed in writing by the TPO sheet roofing system manufacturer and have a minimum of five years experience as an approved, authorized, or licensed applicator with that manufacturer and be approved at a level capable of providing the specified warranty. Supply the names, locations and client contact information of five projects, within the previous three years, of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project.

1.5.3 Qualification of Engineer of Record

Engineer of Record must be currently licensed within the jurisdiction of the project.

Engineer of Record must provide certified engineering calculations for:

Wind uplift requirements in accordance with Local and State codes

ASCE 7, in accordance with ICC IBC.

Seismic requirements per local and state building codes

Seismic requirements per ICC IBC Chapter 16, Section 1613

Snow load requirements per ICC IBC Chapter 16 Section 1608 and Section 7 of ASCE 7

1.5.4 Conformance and Compatibility

Provide an entire roofing and flashing system that is in accordance with specified and indicated requirements, including fire and wind resistance.

1.5.5 Preroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference to review the following:

- a. Drawings, including roof plan, specifications and submittals related to the roof work. Field inspection and verification of all existing conditions, including all fire safety issues, existing structure, and existing materials, including concealed combustibles, which may require additional protection during installation.
- b. Roof system components installation;
- c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, and roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative to roof manufacturer;
- d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and
- e. Quality control(NRCA 3619) plan for the roof system installation;
- f. Safety requirements.

Coordinate preroofing conference scheduling with the Contracting Officer. The conference must be attended by the Contractor, the Contracting Officer's designated personnel, personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, designated safety personnel trained to enforce and copy with ASSE/SAFE A10.24, and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.6 DETAIL DRAWINGS

Submit roof plan depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, spacing of perimeter, corner, and infield fasteners, as applicable. Provide drawings that reflect the project roof plan of each roof level and conditions indicated. Submit bids with approved detail drawings and specifications approved and furnished by the TPO membrane manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Delivery

Deliver materials in the manufacturer's original, unopened containers and rolls with labels intact and legible. Mark and remove wet or damaged materials from the site. Where materials are covered by a referenced specification number, the container must bear the specification number, type, class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.7.2 Storage

Protect materials against moisture absorption and contamination or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof. Provide sufficient ventilation to prevent condensation. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

- a. Maintain a minimum distance of 35 foot for all stored flammable materials, including materials covered with shrink wraps, craft paper or tarps from all torch/welding applications.
- b. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the Contracting Officer.

1.7.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment to prevent damage to materials or applied roofing.

1.8 ENVIRONMENTAL REQUIREMENTS

Do not install roofing system when air temperature is below 40 degrees F, during any form of precipitation, including fog, or when there is ice, frost, moisture, or any other visible dampness on the roof deck. Follow

manufacturer's printed instructions for Cold Weather Installation.

1.9 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing in accordance with NRCA 3740, are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Apply roofing immediately following application of insulation as a continuous operation. Coordinate roofing operations with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.10 WARRANTY

Provide roof system material and workmanship warranties. Provide revision or amendment to standard membrane manufacturer warranty as required to comply with the specified requirements. Provide a manufacturer's warranty that has no dollar limit, covers full system water-tightness, and has a minimum duration of 20 years. Submit sample certificate.

1.10.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year, no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. Provide warranty directly to the Government and commence warranty effective date at time of Government's acceptance of the roof work. The warranty must state that:

- a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, splits, tears, cracks, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.
- b. When the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others does not void the warranty.

1.10.2 Roofing System Installer Warranty

The roof system installer must warrant for a minimum period of two years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.10.3 Continuance of Warranty

Repair or replacement work that becomes necessary within the warranty period must be approved, as required, and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the manufacturer warranty for the remainder of the manufacturer warranty period.

PART 2 PRODUCTS

2.1 MATERIALS

Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Protect materials provided from defects and make suitable for the service and climatic conditions of the installation.

2.1.1 TPO Roof Membrane

Provide a minimum polymer thickness 80 mil nominal reinforced TPO as specified herein. Provide TPO system capable of obtaining 20 year warranties and as listed in the applicable wind uplift and fire rating classification listings.

Submit Data as required by Section 07 22 00 ROOF AND DECK INSULATION together with requirements of this section. Provide data that includes written acceptance by the roof membrane manufacturer of the insulation and other products and accessories to be provided by and warranted under the full system guarantee of the roof membrane manufacturer.

- a. Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Provide materials free of defects and suitable for the service and climatic conditions of the installation. Provide warranted roof system in which all components are sourced from the TPO roof membrane manufacturer, including but not limited to all insulation, coverboards, accessories, adhesives and edge metal.
- b. For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Provide card that is 8 1/2 by 11 inches minimum. On the information card identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing Contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Install card at roof top or access location as directed by the Contracting Officer and provide a paper copy to the Contracting Officer.

2.1.2 Energy Star

Provide a roof membrane that is Energy Star labeled. Provide data

identifying Energy Star label for roof membrane product.

2.1.3 Energy Performance

Install a roof system that meets an overall performance as specified on the drawings or by insulation specified in other sections. The roofing system will need to meet the criteria for Cool Roof Products. Provide emittance and reflectance percentages, and solar reflectance index values to meet sustainable third party certification requirements for Heat Island Reduction.

2.1.4 Bonding Adhesive

Provide TPO membrane manufacturer's recommended adhesive, as supplied by roof membrane manufacturer, and recommended by the manufacturer's printed data for bonding of TPO membrane materials to acceptable insulation, wood, metal, concrete or other acceptable substrate materials. Do not use bonding adhesive to bond membrane materials to each other.

2.1.5 Water Cutoff Mastic/Water Block

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.6 Membrane Flashing

Provide membrane flashing, perimeter flashing, flashing around roof penetrations and prefabricated pipe seals, of a minimum polymer thickness 80 mil nominal reinforced TPO for 20 year warranties, and utilized as recommended and supplied by the roof membrane manufacturer or minimum 80 mil nominal thick reinforced TPO roof membrane and flashings for 20 year warranties. Submit certification from TPO membrane manufacturer that the proposed TPO membrane roofing product meets the minimum polymer thickness specified.

2.1.7 Membrane Fasteners and Plates

Coated, corrosion-resistant fasteners as recommended and supplied by the TPO roof membrane manufacturer and meeting the requirements of FM 4470 and FM RoofNav (www.roofnav.com) or FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. Fasteners and plates to be supplied and warranted for the substrate type(s) by TPO membrane manufacturer and recommended by TPO membrane manufacturer's printed data.

2.1.7.1 Stress Plates, Bar or Rail for Fasteners

Utilize corrosion-resistant stress plates as recommended by the roof membrane manufacturer's printed instructions and meeting the requirements of FM 4470. Stress plates to be supplied by TPO roof membrane manufacturer. Form stress plates to prevent dishing or cupping. Manufacturer-supplied anchoring bar or rails may be utilized for high wind conditions.

2.1.7.2 Auxiliary Fasteners

Provide corrosion resistant screws, nails, or anchors suitable for intended attachment purpose and be recommended and supplied for use by the TPO roof membrane manufacturer.

2.1.8 Pre-manufactured Accessories

Provide pre-manufactured accessories shall be manufacturer's standard for intended purpose, must comply with applicable specification section, be compatible with the membrane roof system and approved for use and supplied by the TPO roof membrane manufacturer. Provide pre-fabricated curbs of 16 gauge AZ55 galvalume with minimum 4 inch flange for attachment to roof nailers. Provide curbs of minimum height of 10 inches above the finished roof membrane surface.

2.1.9 TPO Walk Tread

Scrim reinforced 0.096 inch thickness TPO membrane with a textured surface, compatible with and supplied by manufacturer of the TPO roof membrane.

2.1.10 Roof Insulation

Provide insulation system and facer material compatible with membrane application specified and be approved and supplied by the TPO membrane roof manufacturer and as specified in Section 07 22 00 ROOF AND DECK INSULATION. Provide data identifying percentage of recycled content for insulation.

2.1.11 Wood Products

As specified in Section 06 10 00 ROUGH CARPENTRY, except that fire retardant treated materials must not be in contact with TPO membrane or TPO accessory products, unless approved by the membrane manufacturer and the Contracting Officer.

2.2 Reinforced, Thermoplastic-Polyolefin (TPO) Membrane

Provide reinforced Thermoplastic-Polyolefin (TPO) membrane containing fibers or scrim, and complying with ASTM D4434/D4434M, ASTM D6878/D6878M, and in all cases provide 80 mil nominal minimum thickness for adhered application. Notwithstanding the ASTM standards referenced, provide reinforced TPO roof membranes having the minimum, labeled thickness specified. Provide principal polymer Thermoplastic-Polyolefin used in manufacture of the membrane sheet as TPO, with width and length of TPO membrane roofing sheet consistent with membrane attachment methods and wind uplift requirements, and sheet size as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Maximum reinforced TPO membrane roofing sheet dimensions to be the maximum width obtainable from TPO membrane roof manufacturer in order to minimize seams in the field of the roof. Give preference to recycled content for TPO of minimum 10 percent.

2.3 Horizontal Lifeline Fall Protection System (Delegated Design)

Provide a complete roof top fall protection system as required by OSHA 1910.140 fall protection regulations and selecting equipment that complies with ANSI/ASSE Z359 Standards. and state regulations and standards. Follow manufacturer's installation procedures and standards.

Materials used in fall protection equipment shall be type 316 stainless steel and shall comply with the provisions and requirements of American National Standards Institute, ANSI/ASSE Z359 Fall Protection Code,

ANSI/ASSE A1264.1 Standard and DOL - 29 CFR Part 1910, Subpart D \3\and Subpart 1. /3

Performance Requirements:

a. The Fall Protection System shall be designed to allow users to walk the entire length of the system without having to disconnect from the system to pass through intermediate support points. The system shall be designed to support required number of users in case of a fall and to prevent the users from free falling more than 6 feet. All components shall be designed by the fall protection system supplier and shall meet the applicable requirements of ANSI and applicable OSHA regulations.

b. Structural Performance:

1. Structure supporting Horizontal Lifeline system must be capable of with standing design loads as required by governing regulations and codes. Where component design loads are specified herein, they represent design minimum requirements.
2. All horizontal lifelines shall be designed with a minimum 2:1 safety factor.

c. General Requirements:

1. Horizontal lifelines shall be designed and installed, under the supervision of a Qualified Person, as part of a complete personal Fall Protection system.
2. The horizontal lifeline must be level (less than a 5% grade).
3. Engineers shall, at minimum determine the performance of the system when a fall occurs on the shortest span (largest forces) and the longest span (largest total fall distance) in the system.
4. The HLL(s) constant force energy absorbers shall not be used to limit the maximum arrest force of the worker. The HLL(s) constant force energy absorbers shall be used only to control or reduce the maximum arrest load on the structure.
5. Anchorages for horizontal lifelines systems shall be verified and designed, prior to use, by a Qualified Person with experience and training in designing and using horizontal lifelines systems.
6. HLL(s) shall satisfy the seismic conditions for nonstructural components as described by ASCE/SEI 7 and the most current edition of the IBC. No exceptions can be taken if the system is required to function for life-safety purposes after an earthquake.
7. The fall arrest system shall consist of a stainless steel safety cable attached to the structure. The cable shall be continuous or shall have swaged splices, which allow the user to pass without disconnecting from the system.
8. Brackets and supports shall be attached to the structure with appropriate anchors of proper size to adequately support the intended loaded.

9. The HLL(s) shall comply iwth manufacturer's design requirements.
- d. Restraint HLL(s) shall be designed per ANSI Z359.2 & ANSI Z359.6:
 1. The HLL(s) shall prevent workers from reaching and falling into any open hole or off the edge of a working surface.
 2. The horizontal lifeline shall comply with the requirements for fall arrest horizontal lifelines as indicated in this document.
 3. Where a worker is using a full body harness the force on the worker's body shall not exceed 400 lbs.
 4. HLL constant force energy absorbers may be used in travel restraint systems; provided that the engineer has determined that the restraint forces will not cause the HLL constant force energy absorbers to deploy and ensures that the deflection of the wire rope in combination with other deformations of the restraint system will not permit the worker(s) to reach the fall hazard.
 5. The use of fall restraint systems shall be limited to surfaces at or less than a slope of 4:12 from the horizontal. This is so a fall will not result in dynamic loading on the fall restraint system or where the authorized person could end up being suspended vertically from the system.
- e. Fall Arrest HLL(s) shall be designed per ANSI Z359.2 & ANSI Z359.6:
 1. The selection, design, and installation of fall arrest horizontal lifelines shall be performed under the supervision of a Qualified Person.
 2. Fall arrest horizontal lifelines shall have the strength capable of sustaining static loads applied to the wire rope of at least two times the maximum arresting force.
 3. When more than one user is attached to a horizontal lifeline, the load on the lifeline can be determined using either lumped mass or sequential fall as described in ANSI Z359.6 (6.3.6).
 4. The swing fall shall comply with ANSI Z359.6 (5.).
 5. The clearance safety margin shall comply with ANSI Z359.6.

PART 3 EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

- a. Do not install items that show visual evidence of biological growth.
- b. Drains, curbs, control joints, perimeter walls, roof penetrating components, and equipment supports are in place.
- c. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.

- d. Substrate is sloped to provide positive drainage.
- e. Walls and vertical surfaces are constructed to receive counterflashing, and will permit mechanical fastening of the base flashing materials.
- f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inches above finished roofing surface.
- g. Pressure-preservative treated wood nailers are fastened in place at openings, and intersections with vertical surfaces for securing of membrane, edging strips, attachment flanges of sheet metal, and roof fixtures. Surface-applied nailers are the same thickness as the roof insulation.
- h. TPO materials are not in contact with fire retardant treated wood, except as approved by the TPO membrane roof manufacturer and Contracting Officer.
- i. Exposed nail heads in wood substrates are properly set. Warped and split boards have been replaced. There are no cracks or end joints 1/4 inch in width or greater.
- j. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is attached as specified in Section 07 22 00 ROOF AND DECK INSULATION. Insulation is being roofed over on the same day the insulation is installed.

3.2 APPLICATION METHOD

Apply entire TPO membrane roofing utilizing adhered application methods. Apply roofing materials as specified herein unless approved otherwise by the Contracting Officer.

3.2.1 Special Precautions

- a. Do not dilute coatings or sealants unless specifically recommended by the material manufacturer's printed application instructions. Do not thin liquid materials or cleaners used for cleaning TPO sheet.
- b. Keep liquids in airtight containers, and keep containers closed except when removing materials.
- c. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 60 to 80 degrees F prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some thermoplastic sheets and insulations; follow adhesive manufacturer's printed application instructions. Mix and use liquid components in accordance with label directions and manufacturer's printed instructions.
- d. Provide clean, dry cloths or pads for applying membrane cleaners and cleaning of membrane.
- e. Do not use heat guns or open flame to expedite drying of adhesives or primers.

- f. Require workmen and others who walk on the membrane to wear clean, soft-soled shoes to avoid damage to roofing materials.
- g. Do not use equipment with sharp edges which could puncture the TPO membrane roofing sheet.
- h. Shut down air intakes and any related mechanical systems and seal open vents and air intakes when applying solvent-based materials in the area of the opening or intake. Coordinate shutdowns with the Contracting Officer.

3.2.2 TPO Roofing Membrane

Provide a watertight roof membrane sheet free of contaminants and defects that might affect serviceability. Provide a uniform, straight, and flat edge. Provide membrane overlap of a minimum of 3 inches at sides for adhered applications and 5.5-7 inches for mechanically fastened applications and minimum 4 inches at ends. Direction of laps must allow water to flow over and not against the lap. Install membrane joints that are free of wrinkles and fishmouths. During the day of installation, probe the entire length of hot-air-welded seams and correct any deficiencies. Reweld defective areas. Cut out any fishmouths, or damaged areas and cover the area with membrane using a continuous hot-air-welded seam on all sides. Probe test repairs for continuity. Hot-air-welded seams are to be accomplished in accordance with the TPO membrane roofing manufacturer's published requirements.

3.2.2.1 Nailing

Fasten membrane to nailers in accordance with the membrane manufacturer's approved instructions. Unless otherwise specified, stagger nails on 4 inch centers maximum; stagger screws for sheet metal on 8 inch centers maximum; and install rows of fasteners at least 1/2 inch from edges of sheet metal.

3.2.2.2 Flashing

Flash all roof edges, projections through the roof and changes in roof planes. Seal the seam a minimum of 3 inches beyond the fasteners which attach the membrane to nailers. Secure the installed flashing at the top of the flashing a maximum of 12 inches on centers under the counterflashing or cap. Where possible, install prefabricated components for pipe seals and flashing accessories.

3.2.2.3 Cutoffs

If work is terminated prior to weatherproofing the entire roof, seal the membrane to the roof deck. Also, seal flutes in metal decking along the cutoff edge. Pull the membrane free or cut to expose the insulation when resuming work and remove the cut insulation sheets used for fill-in. Do not use asphalt or coal-tar products for sealing.

3.2.2.4 Walkways

Install walkways on a loose-laid pad of the membrane material extending at least 1 inch beyond the walkway material, and as specified by the manufacturer. Do not place stone ballast below or above walkways.

3.2.3 Adhered Membrane Application

Layout membrane and side lap adjoining sheets in accordance with membrane manufacturer's printed installation instructions. Allow for sufficient membrane to form proper membrane terminations. Remove dusting agents and dirt from membrane and substrate areas where bonding adhesives are to be applied. Apply specified adhesive evenly and continuously to substrate and underside of sheets at rates recommended by the roof membrane manufacturer's printed application instructions. When adhesive is spray applied, roll with a paint roller to ensure proper contact and coverage. Do not apply bonding adhesive to surfaces of membrane in seam or lap areas. Allow adhesive to flash off or dry to consistency prescribed by manufacturer before adhering sheets to the substrate. When adhesive is peel and stick release paper-activated, follow manufacturer's printed instructions. Roll each sheet into adhesive slowly and evenly to avoid wrinkles; broom or roll the membrane to remove air pockets and fishmouths and to ensure adequately uniform bonding of sheet to substrate. Form field hot-air-welded laps or seams as specified and ensure that hot-air welded dimension is at width required by the membrane manufacturer's installation instructions. Check all seams and continuous hot-air-weld of all seams and lap seals.

3.2.4 Perimeter Attachment

Adhesive bond or mechanically secure roof membrane sheet at roof perimeter in a manner to comply with wind resistance requirements and in accordance with membrane manufacturer's printed application instructions. When adhesively bonding a mechanically fastened system in perimeter areas, the perimeter boundary of the adhesive bond must be the same as the boundary required for additional perimeter mechanical fastening to meet wind resistance requirements.

3.2.5 Securement at Base Tie-In Conditions

Mechanically fasten the roof membrane at penetrations, at base of curbs and walls, and at all locations where the membrane turns and angles greater than 4 degrees (1:12). Space fasteners a maximum of 12 inches on center, except where more frequent attachment is required to meet specified wind resistance or where recommended by the roof membrane manufacturer. Cover over fasteners with a layer of flashing material. Hot-air-weld all seams of flashing material as recommended by the roof membrane manufacturer's printed data.

3.2.6 Pre-fabricated Curbs

Securely anchor prefabricated curbs to nailer or other base substrate and flashed with TPO membrane flashing materials.

3.2.6.1 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories, or isolated paver block, are set on the membrane, adhere reinforced membrane or walkpad material, as recommended by the roof membrane manufacturer, to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.2.7 Roof Walkways

Install walkways at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the membrane roof manufacturer's printed instructions. Provide minimum 6 inch separation between adjacent walkways to accommodate drainage.

3.3 FLASHINGS

Provide flashings in the angles formed at walls and other vertical surfaces and where required to make the work watertight, except where metal flashings are indicated.

3.3.1 General

Provide a one-ply flashing membrane, as specified for the system used, and install immediately after the roofing membrane is placed and prior to finish coating where a finish coating is required. Flashings must be stepped where vertical surfaces abut sloped roof surfaces. Provide sheet metal reglet in which sheet metal cap flashings are installed of not more than 16 inch nor less than 8 inch above the roofing surfaces. Exposed joints and end laps of flashing membrane must be made and sealed in the manner required for roofing membrane.

3.3.2 Membrane Flashing

3.3.2.1 Installation

Install flashing and flashing accessories as the roof membrane is installed. Apply flashing to cleaned surfaces and as recommended by the roof membrane manufacturer and as specified. Utilize cured TPO membrane flashing and prefabricated accessory flashings to the maximum extent recommended by the roof membrane manufacturer. Limit uncured flashing material to reinforcing inside and outside corners and angle changes in plane of membrane, and to flashing scuppers, pourable sealer pockets, and other formed penetrations or unusually shaped conditions as recommended by the roof membrane manufacturer where the use of cured material is impractical. Extend base flashing not less than 8 inch above roofing surface and as necessary to provide for seaming overlap on roof membrane as recommended by the roof membrane manufacturer.

3.3.2.2 Sealing

Seal flashing membrane for a minimum of 3 inch on each side of fastening device used to anchor roof membrane to nailers. Completely adhere flashing sheets in place. Seam flashing membrane in the same manner as roof membrane, except as otherwise recommended by the membrane manufacturer's printed instructions and approved by the Contracting Officer. Reinforce all corners and angle transitions by applying uncured membrane to the area in accordance with roof membrane manufacturer recommendations. Mechanically fasten top edge of base flashing with manufacturer recommended termination bar fastened at maximum 12 inch on center. Install sheet metal flashing over the termination bar in the completed work. Mechanically fasten top edge of base flashing for all other terminations in a manner recommended by the roof membrane manufacturer. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

3.4 PROTECTION FROM BEARING SUPPORT

Provide for protection of roof membrane by placing reinforced membrane or walkpad material, or other material approved by the Contracting Officer, at all surface bearing support locations.

3.5 CORRECTION OF DEFICIENCIES

Where any form of deficiency is found, take additional measures as deemed necessary by the Contracting Officer to determine the extent of the deficiency and provide corrective action recommendations. Perform corrective action as directed by the Contracting Officer.

3.6 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied membrane roofing system from water intrusion.

3.6.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of the roof membrane system in an effective manner. Seal off flutes in metal decking along the cutoff edge. Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.6.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.

3.6.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing system. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.7 REGISTERED ROOF OBSERVER

The Contractor is required to provide a IIBEC (Registered Roof Observer (RRO)) during all roof related construction activities. The RRO will perform daily oversight and quality control on all roof work to assure compliance with the plans and specifications. The RRO will supply recommendations and reports to the Government for review. The RRO shall provide daily reports per CQC requirements, number of squares of roof placed and the contractor's compliance with specifications and details.

3.7.1 RRO Communication with the Government

The RRO shall submit all plans, schedules, report, and documentation directly to the Contracting Officer's Representative' concurrent with submission to the CQC System Manager. The RRO shall have direct communication with Contracting Officer's Representative regarding all elements of the roofing installation.

3.8 FIELD QUALITY CONTROL

3.8.1 Construction Monitoring

During progress of the roof work, make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

- a. Equipment is in working order. Metering devices are accurate.
- b. Materials are not installed in adverse weather conditions.
- c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.
 - (1) Nailers and blocking are provided where and as needed.
 - (2) Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.
 - (3) The proper number, type, and spacing of fasteners are installed.
 - (4) Materials comply with the specified requirements.
 - (5) All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed prior to application.
 - (6) Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required, including additional fastening of membrane in corner and perimeter areas as required.
 - (7) Membrane is properly overlapped.
 - (8) Membrane seaming is as specified by TPO membrane manufacturer. All seams are checked at the end of each work day.
 - (9) Applied membrane is inspected and repaired as necessary prior to paver installation.
 - (10) Membrane is adhered without ridges, wrinkles, kinks, fishmouths.
 - (11) Installer adheres to specified and detailed application parameters.
 - (12) Associated flashing's and sheet metal are installed in a timely manner in accord with the specified requirements.
 - (13) Paver ballast is within the specified weight range.
 - (14) Temporary protection measures are in place at the end of each work shift.

3.8.2 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of 3

times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections must occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections need not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the Contracting Officer. After each inspection, a report, signed by the manufacturer's technical representative to the roofing Contractor and then to the Contracting Officer within 3 working days. Within the report state the overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.9 CLEAN UP

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.10 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations. Include copies of Safety Data Sheets for maintenance/repair materials.

3.11 ROOF DRAIN TEST

After completing roofing but prior to Government acceptance, perform the following test for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 60 00

FLASHING AND SHEET METAL

05/17, CHG 2: 11/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
- 1.3 SUBMITTALS
- 1.4 MISCELLANEOUS REQUIREMENTS
 - 1.4.1 Product Data
 - 1.4.2 Finish Samples
 - 1.4.3 Operation and Maintenance Data
- 1.5 DELIVERY, HANDLING, AND STORAGE

PART 2 PRODUCTS

- 2.1 RECYCLED CONTENT
- 2.2 MATERIALS
 - 2.2.1 Exposed Sheet Metal Items
 - 2.2.2 Drainage
 - 2.2.3 Steel Sheet, Zinc-Coated (Galvanized)
 - 2.2.4 Zinc Sheet and Strip
 - 2.2.5 Stainless Steel
 - 2.2.6 Terne-Coated Steel
 - 2.2.7 Aluminum Alloy Sheet and Plate
 - 2.2.7.1 Alclad
 - 2.2.8 Finishes
 - 2.2.9 Scuppers
 - 2.2.10 Conductor Heads
 - 2.2.11 Splash Pans
 - 2.2.12 Copings
 - 2.2.13 Fasteners

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Workmanship
 - 3.1.2 Nailing
 - 3.1.3 Cleats
 - 3.1.4 Bolts, Rivets, and Screws
 - 3.1.5 Seams
 - 3.1.5.1 Flat-lock Seams
 - 3.1.5.2 Flat Seams
 - 3.1.6 Soldering
 - 3.1.6.1 Edges
 - 3.1.7 Welding and Mechanical Fastening
 - 3.1.7.1 Welding of Aluminum
 - 3.1.7.2 Mechanical Fastening of Aluminum
 - 3.1.8 Protection from Contact with Dissimilar Materials

- 3.1.8.1 Aluminum
- 3.1.8.2 Metal Surfaces
- 3.1.8.3 Wood or Other Absorptive Materials
- 3.1.9 Expansion and Contraction
- 3.1.10 Base Flashing
- 3.1.11 Counterflashing
- 3.1.12 Metal Reglets
- 3.1.13 Gravel Stops and fascia
 - 3.1.13.1 Edge Strip
 - 3.1.13.2 Joints
- 3.1.14 Downspouts
 - 3.1.14.1 Terminations
- 3.1.15 Scuppers
- 3.1.16 Conductor Heads
- 3.1.17 Splash Pans
- 3.1.18 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces
- 3.1.19 Flashing at Roof Penetrations and Equipment Supports
- 3.1.20 Single Pipe Vents
- 3.1.21 Copings
- 3.2 PAINTING
 - 3.2.1 Aluminum Surfaces
- 3.3 CLEANING
- 3.4 REPAIRS TO FINISH
- 3.5 FIELD QUALITY CONTROL
 - 3.5.1 Procedure

ATTACHMENTS:

Table II

-- End of Section Table of Contents --

SECTION 07 60 00

FLASHING AND SHEET METAL
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 WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2014; Errata 1 2014; Errata 2 2020)
Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A308/A308M (2010) Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process

ASTM A480/A480M (2020a) Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B69 (2020) Standard Specification for Rolled Zinc

ASTM B209 (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793 (2012) Architectural Sheet Metal Manual, 7th Edition

1.2 GENERAL REQUIREMENTS

Finished sheet metal assemblies must form a weathertight enclosure without waves, warps, buckles, fastening stresses or distortion, while allowing for expansion and contraction without damage to the system. The sheet metal installer is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal modifications required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous, uninterrupted roofing operations.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" 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

- Exposed Sheet Metal Coverings; G
- Conductor Heads; G
- Downspouts; G
- Gravel Stops and fascia; G
- Splash Pans; G
- Base Flashing; G
- Counterflashing; G
- Flashing at Roof Penetrations and Equipment Supports; G
- Reglets; G
- Scuppers; G
- Copings; G
- Conductor Heads; G
- Recycled Content; S

SD-04 Samples

- Finish Samples; G

SD-08 Manufacturer's Instructions

- Instructions for Installation; G
- Quality Control Plan; G

SD-10 Operation and Maintenance Data

- Cleaning and Maintenance; G

1.4 MISCELLANEOUS REQUIREMENTS

1.4.1 Product Data

Indicate thicknesses, dimensions, fastenings, anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.4.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.4.3 Operation and Maintenance Data

Submit detailed instructions for installation and quality control during installation, cleaning and maintenance, for each type of assembly indicated.

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until installation.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide data for each product with recycled content, identifying percentage of recycled content.

2.2 MATERIALS

Do not use lead, lead-coated metal, or galvanized steel. Use any metal listed by SMACNA 1793 for a particular item, unless otherwise indicated. Provide materials, thicknesses, and configurations in accordance with SMACNA 1793 for each material. Different items need not be of the same metal, except that contact between dissimilar metals must be avoided.

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used, except as follows:

2.2.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascia; cap, valley, steeped, base, and eave flashings and related accessories.

2.2.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such

items.

2.2.3 Steel Sheet, Zinc-Coated (Galvanized)

Provide in accordance with ASTM A653/A653M.

2.2.4 Zinc Sheet and Strip

Provide in accordance with ASTM B69, Type I, a minimum of 0.024 inch thick.

2.2.5 Stainless Steel

Provide in accordance with ASTM A480/A480M, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.2.6 Terne-Coated Steel

Provide in accordance with ASTM A308/A308M, a minimum of 14 by 20 inch with minimum of 40 pound coating per double base box. ASTM A308/A308M.

2.2.7 Aluminum Alloy Sheet and Plate

Provide in accordance with ASTM B209 color as indicated form alloy, and temper appropriate for use. Provide material not less than 0.065-in in thickness.

2.2.7.1 Alclad

When fabricated of aluminum, fabricate the following items with Alclad 3003, Alclad 3004, or Alclad 3005, clad on both sides unless otherwise indicated.

- a. Downspouts, and hangers
- b. Gravel stops and fascia
- c. Flashing

2.2.8 Finishes

Provide exposed exterior sheet metal and aluminum with a baked on, factory applied color coating of polyvinylidene fluoride (PVF2) or approved equal fluorocarbon coating. Dry film thickness of coatings must be 0.8 to 1.3 mils. Color to be selected from as indicated on the Drawings. Field applications of color coatings are prohibited and will be rejected.

2.2.9 Scuppers

Line interiors of scupper openings with sheet metal. Provide a drip edge at bottom edges with returns of not less than one inch against the face of the outside wall at the top and sides. Provide the perimeter of the lining approximately 1/2 inch less than the perimeter of the scupper.

2.2.10 Conductor Heads

Provide conductor heads and screens in the same material as downspouts. Provide outlet tubes not less than 4 inches long.

2.2.11 Splash Pans

Provide splash pans where downspouts discharge onto roof surfaces and at locations indicated. Unless otherwise indicated, provide pans not less than 24 inches long by 18 inches wide with metal ribs across bottoms of pans. Provide sides of pans with vertical baffles not less than one inch high in the front, and 4 inches high in the back.

2.2.12 Copings

Unless otherwise indicated, provide copings in .05 aluminum.

2.2.13 Fasteners

Use the same metal as, or a metal compatible with the item fastened. Confirm compatibility of fasteners and items to be fastened to avoid galvanic corrosion due to dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.2 Nailing

Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inches. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inch on center and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work. Secure flashing at one-half the normal interval to ensure a wind-resistant installation.

3.1.3 Cleats

Provide continuous cleats of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry. Pre-tin cleats for soldered seams.

3.1.4 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 0.040 inches or less in thickness.

3.1.5 Seams

Straight and uniform in width and height with no solder showing on the face.

3.1.5.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.5.2 Flat Seams

Make seams in the direction of the flow.

3.1.6 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pre-tin edges of sheet metal before soldering is begun. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.6.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pre-tinned. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.1.7 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 0.040 inch. Aluminum 0.040 inch or less in thickness must be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

3.1.7.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2/D1.2M.

3.1.7.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space fasteners 12 inches maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inches from the end of the overlapping sheet.

3.1.8 Protection from Contact with Dissimilar Materials

3.1.8.1 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint. Aluminum may be used over concrete construction, provided that required reglets are of stainless steel and aluminum surface in contact with concrete or masonry is coated with bituminous paint or zinc chromate primer.

3.1.8.2 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.8.3 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.9 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascia by expansion and contraction joints spaced not more than 12 feet apart.

3.1.10 Base Flashing

Extend up vertical surfaces of the flashing not less than 8 inches and not less than 4 inches under the roof covering. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inches. Overlap the flashing strips with the previously laid flashing not less than 3 inches. Fasten the strips at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inches on center with hex headed, galvanized shielded screws a minimum of 2 inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of chimneys, curbs, and similar vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 4.5 inches at the lower side of chimneys, and similar vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and exterior corners. Do not use metal base flashing on built-up roofing.

3.1.11 Counterflashing

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inches above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inches. Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum 8 inches by 8 inches or may be of the preformed single piece type. Provide end laps in counterflashings not less than 3 inches and make it weathertight with plastic cement. Do not make lengths of metal counterflashings exceed 10 feet. Form flashings to the required shapes before installation. Factory form corners not less than 12 inches from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inches apart; on chimneys and stair/elevator towers short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inches into the walls. Install counterflashing to provide a spring action against base flashing.

3.1.12 Metal Reglets

Keep temporary cores in place during installation. Ensure factory fabricated caulked type or friction type, reglets have a minimum opening of 1/4 inch and a minimum depth of 1-1/4 inch, when installed.

3.1.13 Gravel Stops and fascia

Prefabricate in the shapes and sizes indicated and in lengths not less than 8 feet. Extend flange at least 4 inches onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascia after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascia on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in. Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inch long spaced not more than 3 inches on center, in two staggered rows.

3.1.13.1 Edge Strip

Hook the lower edge of fascia at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inches maximum on center. Where fastening is made to concrete or masonry, use screws spaced 12 inches on center driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16 inch thick compatible spacer or washers.

3.1.13.2 Joints

Leave open the section ends of gravel stops and fascia 1/4 inch and backed with a formed flashing plate, mechanically fastened in place and lapping each section end a minimum of 4 inches set laps in plastic cement. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascia in accordance with the manufacturer's printed

instructions and details.

3.1.14 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the masonry or substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.14.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

3.1.15 Scuppers

Extend the scupper liner through and project outside of, the wall it penetrates to form a bottom drip edge against the face of the wall. Fold outside edges under 1/2 inch on all sides. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement.

3.1.16 Conductor Heads

Set the depth of the top opening equal to two-thirds of the width or the conductor head. Flat-lock solder seams. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 2 inches wider than the scupper. Attach conductor heads to the wall with masonry fasteners. Securely fasten screens to heads.

3.1.17 Splash Pans

Install splash pans lapped with horizontal roof flanges not less than 4 inches wide to form a continuous surface. Bend the rear flange of the pan to contour of can't strip and extend up 6 inches under the side wall covering or to height of base flashing under counterflashing. Bed the pans and roof flanges in plastic bituminous cement and strip-flash as specified.

3.1.18 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 16 by 18 inches. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by

aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

3.1.19 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

3.1.20 Single Pipe Vents

See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 3 inches on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inches roof flange in bituminous plastic cement and nailed 3 inches on center. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.1.21 Copings

Provide coping with locked seam. Terminate outer edges in edge strips. Install with sealed lap joints as indicated.

3.2 PAINTING

Touch ups in the field may be applied only after metal substrates have been cleaned and pretreated in accordance with manufacturer's written instructions and products.

Field-paint sheet metal for separation of dissimilar materials.

3.2.1 Aluminum Surfaces

Clean with solvent and apply one coat of zinc-molybdate primer and one coat of aluminum paint.

3.3 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.4 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.5 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet

metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

- a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- b. Verification that specified material is provided and installed.
- c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.5.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the Contracting Officer at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	Copper kilograms per square foot	Aluminum, inch	Stainless Steel, inch	Terne-Coated Stainless Steel, inch	Zinc-Coated Steel, U.S. Std. Gage
Cover	16	.032	.015	.015	24
Waterstop-bellows or flanged, U-type.	16	-	.015	.015	-
Covering on minor flat, pitched or curved surfaces	20	.040	.018	.018	-
Downspouts and leaders	16	.032	.015	.015	24
Downspout clips and anchors	-	.040 clip .125 anchor	-	-	-
Downspout straps, 2-inch	48 (a)	.060	.050	-	-
Conductor heads	16	.032	.015	.015	-
Strainers, wire diameter or gage	No. 9 gage	.144 diameter	.109 diameter	-	
Flashings:					

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	Copper kilograms per square foot	Aluminum, inch	Stainless Steel, inch	Terne-Coated Stainless Steel, inch	Zinc-Coated Steel, U.S. Std. Gage
Base	20	.040	.018	.018	24
Cap (Counter-flashing)	16	.032	.015	.015	26
Roof drain	16 (b)				
Pipe vent sleeve (d)					
Coping	16	-	-	-	-
Gravel stops and fascia:					
Extrusions	-	.075	-	-	-
Sheets, corrugated	16	.032	.015	.015	-
Sheets, smooth	20	.050	.018	.018	24
Edge strip	24	.050	.025	-	-
Continuous cleat	16	.032	.015	.015	24
Hangers, dimensions	1 inch by 1/8 inch (a)	1 inch by 1/8 inch (c)	1 inch by 1/8 inch	-	-
Joint Cover plates (See Table II)	16	.032	.015	.015	24
Reglets (c)	10	-	.010	.010	-
Splash pans	16	.040	.018	.018	-
(a) Brass.					
(b) May be lead weighing 4 pounds per square foot.					
(c) May be polyvinyl chloride.					

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	Copper kilograms per square foot	Aluminum, inch	Stainless Steel, inch	Terne-Coated Stainless Steel, inch	Zinc-Coated Steel, U.S. Std. Gage
(d) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph SINGLE PIPE VENTS for optional material.					

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at roof	1.25 inch single lock, standing seam, cleated	1.25 inch single lock, standing	--
Flashings			
Base	One inch 3 inch lap for expansion joint	One inch flat locked, soldered; sealed; 3 inch lap for expansion joint	Aluminum manufacturer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound.
Cap-in reglet	3 inch lap	3 inch lap	Seal groove with joint sealing compound.

TABLE II. SHEET METAL JOINTS			
TYPE OF JOINT			
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Reglets	Butt joint	--	Seal reglet groove with joint sealing compound.
Gravel stops:			
Extrusions	--	Butt with 1/2 inch space	Use sheet flashing beneath and a cover plate
Sheet, smooth	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing backup plate.
Sheet, corrugated	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing beneath and a cover plate or a combination unit
(a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant.			
(b) Seal Polyvinyl chloride reglet with manufacturer's recommended sealant.			

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 81 00

SPRAY-APPLIED FIREPROOFING

02/11

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
 - 1.2.1 General Requirements
 - 1.2.2 Fire Resistance Rating
 - 1.2.3 Evaluation Reports - ICC-ES Reports
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Installer Qualifications
 - 1.4.2 Pre-Installation Meeting
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 PROJECT/SITE CONDITIONS
 - 1.6.1 Temperature
 - 1.6.2 Ventilation

PART 2 PRODUCTS

- 2.1 SPRAY-APPLIED FIREPROOFING
 - 2.1.1 Dry Density and Cohesion/Adhesion
 - 2.1.1.1 Concealed Structural Components
 - 2.1.1.2 Exposed Structural Components
 - 2.1.1.3 Mechanical Rooms and Storage Areas
 - 2.1.2 Deflection
 - 2.1.3 Bond-Impact
 - 2.1.4 Compressive Strength
 - 2.1.5 Corrosion
 - 2.1.6 Air Erosion
- 2.2 SEALER
- 2.3 WATER

PART 3 EXECUTION

- 3.1 SURFACE PREPARATION
- 3.2 PROTECTION
- 3.3 FIREPROOFING MATERIAL
- 3.4 APPLICATION
 - 3.4.1 Sequence
 - 3.4.2 Application Technique
 - 3.4.3 Sealer Application
 - 3.4.4 Applied Thickness
 - 3.4.5 Application of Spray-Applied Intumescent Epoxy Coating System
- 3.5 MANUFACTURER'S SERVICES
 - 3.5.1 General
 - 3.5.2 Manufacturer's Inspection
- 3.6 FIELD TESTS

- 3.6.1 Structural Components
- 3.6.2 Repair
- 3.6.3 Visual Inspections
- 3.6.4 Patching
- 3.7 CLEANUP

-- End of Section Table of Contents --

SECTION 07 81 00

SPRAY-APPLIED FIREPROOFING
02/11

PART 1 GENERAL

1.1 REFERENCES

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

ASSOCIATION OF THE WALL AND CEILING INDUSTRY (AWCI)

AWCI TM 12-A (1997; 3rd Ed) Standard Practice for the Testing and Inspection of Field Applied Sprayed Fire-Resistive Materials; An Annotated Guide

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 E605/E605M (1993; R 2015; E 2015) Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members

ASTM E736 (2000; R 2011) Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members

ASTM E759/E759M (1992; R 2020) Standard Test Method for Effect of Deflection on Sprayed Fire-Resistive Material Applied to Structural Members

ASTM E760/E760M (1992; R 2020) Standard Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members

ASTM E761/E761M (1992; R 2020) Standard Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members

ASTM E859/E859M (1993; R 2020) Standard Test Method for Air Erosion of Sprayed Fire-Resistive Materials (SFRMs) Applied to Structural

Members

ASTM E937/E937M	(1993; R 2020) Standard Test Method for Corrosion of Steel by Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members
ASTM E1042	(2002; R 2021) Standard Classification for Acoustically Absorptive Materials Applied by Trowel or Spray
ASTM G21	(2015; R 2021; E 2021) Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC-ES AC23	(2012; R 2016) Acceptance Criteria for Sprayed Fire-resistant Materials (SFRMs), Intumescent Fire-resistant Coatings and Mastic Fire-resistant Coatings Used to Protect Structural Steel Members
-------------	--

UNDERWRITERS LABORATORIES (UL)

UL 263	(2011; Reprint Aug 2021) UL Standard for Safety Fire Tests of Building Construction and Materials
UL Fire Resistance	(2014) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Protect all structural steel, undersides of steel floors (if required) and steel roof decks (if required) with spray-applied fireproofing to a fire resistance hour-rating as indicated below, unless otherwise indicated.

1.2.2 Fire Resistance Rating

Fire resistance ratings shall be in accordance with the fire rated assemblies listed in UL Fire Resistance. Proposed materials not listed in UL Fire Resistance shall have fire resistance ratings at least equal to the UL Fire Resistance ratings as determined by an approved independent testing laboratory, based on tests specified in UL 263 or ASTM E119. Submit reports and test records, attesting that the fireproofing material conforms to the specified requirements. Each test report shall conform to the report requirements specified by the test method. For the underside of the decking use metal lath installed prior to the fireproofing material or Rigid Board Fireproofing Material as outlined in the UL Fire Resistance Directory Volume 1. Apply fireproofing to structural steel members, with the following hourly fire resistance rating and in accordance with the following UL design or approved equivalent. Use unrestrained fire resistance ratings, unless the architect/engineer has specified that the degree of thermal restraint of the construction meets or exceeds the degree of thermal restraint of the tested assembly. Performance tests shall be in accordance with ASTM E119.

Fire Rating Schedule		
Element	Hourly Rating	UL Design Reference
Columns supporting one floor	As indicated	X854
Columns supporting roof	As indicated	X854
Floor supports	As indicated	D798

1.2.3 Evaluation Reports - ICC-ES Reports

Materials shall be evaluated in accordance with ICC-ES AC23. ICC-ES Reports shall be included as part of the Submittals below. The reports will identify the product as code compliant and having met the physical performance requirements outlined in paragraphs "Dry Density and Cohesion/Adhesion" through "Air Erosion".

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-03 Product Data

Fireproofing Material; G

SD-04 Samples

Spray-Applied Fireproofing; G

SD-06 Test Reports

Fire Resistance Rating; G

Field Tests; G

Evaluation Reports; G

SD-07 Certificates

Installer Qualifications; G

Surface Preparation Report; G

Manufacturer's Inspection Report; G

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

Engage an experienced installer that is certified, licensed, or otherwise qualified by the spray-on fireproofing manufacturer as having the necessary experience, staff, and training to install the manufacturer's products in accordance with specified requirements. Submit manufacturer's certification that each listed installer is qualified and trained to install the specified fireproofing. Show evidence that each fireproofing

installer has had a minimum of 3 years experience in installing the specified type of fireproofing. Each installer of fireproofing material shall be trained, have a minimum of 3 years experience and a minimum of three installations using fireproofing of the type specified. A manufacturer's willingness to sell its products to the Contractor or installer does not infer qualification of the buyer.

1.4.2 Pre-Installation Meeting

Hold a meeting with the installer, field testing agency, the manufacturer, subcontractors (whose employees come into contact with the fireproofing), and the Contracting Officer prior to the installation of any fireproofing material to review the substrates for acceptability, method of application, applied thickness, patching, repair, inspection and testing procedures.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver packaged material in the original unopened containers, marked to show the brand name, the manufacturer, and the UL markings. Keep fireproofing material dry until ready to be used, and store off the ground, under cover and away from damp surfaces. Damaged or opened containers will be rejected. Apply material with shelf-life prior to expiration of the shelf-life.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Temperature

Maintain substrate and ambient air temperatures above 40 degrees F during application and for 24 hours before and after application. Maintain relative humidity within the limits recommended by the fireproofing manufacturer.

1.6.2 Ventilation

Provide adequate ventilation to properly dry the fireproofing after application. In enclosed areas, provide a minimum of 4 air exchanges per hour by forced air circulation.

PART 2 PRODUCTS

2.1 SPRAY-APPLIED FIREPROOFING

Provide spray-applied fireproofing material, including sealer, conforming to ASTM E1042, Class (a), Category A, either Type I or Type II, except that the dust removed shall not exceed 0.0025 gram per square foot of fireproofing material applied as specified in the project. Only products that have been evaluated at UL and bear and "investigated for exterior use" approval are allowed in waterfront areas where the fireproofing may be directly exposed to a natural body of water. Material shall be asbestos free, and shall resist fungus for a period of 28 days when tested in accordance with ASTM G21. Material shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84. Submit one sample panel, 18 inches square, for each specified type of fireproofing. Also, a designated sample area of not less than 100 square feet shall be prepared. Sample area shall be representative of typical installation of fireproofing including metal decks, beams, columns and attachments. Equipment, materials and

procedures used in the sample area shall be the same as, or representative of, that to be used in the work. The sample area shall be approved prior to proceeding with fireproofing work in any other area. The approved sample area shall be used as a reference standard for applied fireproofing material. Sample area shall remain in place and open to observation until all spray-applied fireproofing is completed and accepted, at which time it may become part of the work.

2.1.1.1 Dry Density and Cohesion/Adhesion

Fireproofing shall have a minimum ASTM E605/E605M dry density and ASTM E736 cohesion/adhesion properties as follows:

2.1.1.1.1 Concealed Structural Components

Fireproofing for structural components concealed above the ceiling, or within a wall, chase, or furred space, shall have a minimum applied dry density of 15 pounds per cubic foot and a cohesion/adhesion strength of 200 psf.

2.1.1.1.2 Exposed Structural Components

Fireproofing for exposed structural components, except where otherwise specified or indicated, shall have a minimum applied dry density of 22 pounds per cubic foot and a cohesion/adhesion strength of 434 psf.

2.1.1.1.3 Mechanical Rooms and Storage Areas

Fireproofing for structural components located in mechanical rooms and storage areas shall have a minimum applied dry density of 40 pcf and a cohesion/adhesion strength of 1,000 psf.

2.1.2 Deflection

Spray-applied fireproofing shall not crack, spall, or delaminate when backing to which it is applied is subject to downward deflection 1/120 of 10 foot clear span, when tested in accordance with ASTM E759/E759M.

2.1.3 Bond-Impact

Spray-applied fireproofing material shall not crack, spall or delaminate when tested in accordance with ASTM E760/E760M.

2.1.4 Compressive Strength

The minimum compressive strength shall be 1000 psf when tested in accordance with ASTM E761/E761M.

2.1.5 Corrosion

Spray-applied fireproofing material shall not contribute to corrosion of test panels when tested as specified in ASTM E937/E937M.

2.1.6 Air Erosion

Dust removal shall not exceed 0.025 gram per square foot when tested in accordance with ASTM E859/E859M.

2.2 SEALER

Sealer shall be the type approved by the manufacturer of the fireproofing material, shall be fungus resistant, shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E84, and must be transparent-drying color.

2.3 WATER

Water used for material mixing and surface preparation shall be potable.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Thoroughly clean surfaces to be fireproofed of dirt, grease, oil, paint, primers, loose rust, rolling lubricant, mill scale or other contaminants that will interfere with the proper bonding of the sprayed fireproofing to the substrate. Test painted/primed steel substrates in accordance with ASTM E736, with specified sprayed fireproofing material, to provide the required fire-resistance rating; painted or primed steel surfaces may require a fireproofing bond test to determine if the paint formulation will impair proper adhesion. Certify the acceptability of surfaces to receive sprayed-applied fireproofing by inspection and submit a Surface Preparation Report accordingly. The statement shall list the structural members and the areas that have been inspected and certified. Overhead areas to be fireproofed shall be cleared of all obstructions interfering with the uniform application of the spray-applied fireproofing. Hardware such as support sleeves, inserts, clips, hanger attachment devices and the like shall be installed prior to the application of the fireproofing. Condition of the surfaces shall be acceptable to the manufacturer prior to application of spray-applied fireproofing. Applications listed for use on primed surfaces shall be in accordance with the manufacturer's recommendations and standards, and detailed in submittal item SD-03 Product Data.

3.2 PROTECTION

Cover surfaces not to receive spray-applied fireproofing to prevent contamination by splatter, rebound and overspray. Cover exterior openings in areas to receive spray-applied fireproofing prior to and during application of fireproofing with tarpaulins or other approved material. Clean surfaces not to receive fireproofing of fireproofing and sealer.

3.3 FIREPROOFING MATERIAL

Mix fireproofing material in accordance with the manufacturer's recommendations. Submit data identifying performance characteristics of fireproofing material. Data includes recommended application requirements and indicate thickness of fireproofing to be applied to achieve each required fire rating.

3.4 APPLICATION

3.4.1 Sequence

Prior to application of fireproofing on each floor, the manufacturer shall inspect and approve application equipment, water supply and pressure, and the application procedures. If fireproofing is required to be applied to

underside of steel roof deck and steel floor assemblies, it shall be done only after respective roof or floor construction is complete. No roof or floor traffic shall be allowed during application. Fireproofing material shall be applied prior to the installation of ductwork, piping and conduits which would interfere with uniform application of the fireproofing.

3.4.2 Application Technique

Maintain water pressure and volume to manufacturer's recommendations throughout the fireproofing application. Apply fireproofing material to the thickness and density established for the specified fire resistance rating, in accordance with the procedure recommended by the manufacturer, and to a uniform density and texture. Do not tamp fireproofing material to achieve the desired density.

3.4.3 Sealer Application

If sealer is required by the product used, apply it after field testing has been conducted and after corrective measures and repairs, if required, have been completed.

3.4.4 Applied Thickness

The minimum average thickness shall be no less than 0.375 inches. Thicknesses shall not be less than required to achieve designated fire resistance ratings. If the specified thickness is greater than or equal to 1 inch, any individual measurement shall not be less than the specified thickness minus 0.25 inches. If the specified thickness is less than 1 inch, any individual measurement shall not be less than the specified thickness minus 25 percent.

3.4.5 Application of Spray-Applied Intumescent Epoxy Coating System

Prepare surfaces and apply the spray-applied Intumescent epoxy coating system in accordance with the manufacturer's written recommendations.

3.5 MANUFACTURER'S SERVICES

3.5.1 General

The manufacturer, or its representative, shall be onsite prior to, periodically during, and at completion of the application, to provide the specified inspections and certifications; and to ensure that preparations are adequate and that the material is applied according to manufacturer's recommendations and the contract requirements.

3.5.2 Manufacturer's Inspection

The manufacturer shall inspect the fireproofing work after the work is completed on each floor or area, including testing, repair and clean-up, and shall certify that the work complies with the manufacturer's criteria and recommendations. Before the sprayed material is covered, and after all of the fireproofing work is completed, including repair, testing, and clean-up; and after mechanical, electrical and other work in contact with fireproofing material has been completed, the manufacturer shall re-inspect the work and certify that the entire project complies with the manufacturer's criteria and recommendations. Obtain and submit the Manufacturer's Inspection Report and certifications of approval stating

that the spray-applied fireproofing in the entire project complies with the manufacturer's criteria and recommendations.

3.6 FIELD TESTS

The applied fireproofing shall be tested by an approved independent testing laboratory to be selected by the A/E and paid for by the Contractor. Submit test reports documenting results of tests on the applied material in the project. Report shall include defects identified, repair procedures, and results of the retests when required. Perform the tests in approved locations: for density in accordance with ASTM E736, cohesion/adhesion in accordance with ASTM E736, and for thickness in accordance with ASTM E605/E605M. Determine densities in accordance with ASTM E605/E605M or Appendix A, "Alternate Method for Density Determination" of AWCI TM 12-A. Take density determinations at the flat portion of deck, beam bottom flange, beam web, column, and an equivalent area from the top of the lower beam flange. Areas showing a density less than specified will be rejected. A test sample shall be located every 10,000 square feet of floor area or two for each floor, whichever produces the greatest number of test areas. Any area showing less than minimum requirements shall be corrected. Proposed corrective measures, in writing, shall be approved before starting the corrective action. Corrected work shall be retested.

3.6.1 Structural Components

Test each structural component type at floor and roof decks, beams, columns, joists, and trusses. Minimum average thickness shall be as required by UL Fire Resistance. Density and cohesion/adhesion shall be as specified.

3.6.2 Repair

Additional fireproofing material may be added to provide proper thickness. Correct rejected areas of fireproofing to meet specified requirements by adding fireproofing material to provide the proper thickness, or by removing defects and respraying with new fireproofing material. Use same type of fireproofing material for repairs as originally applied or use patching materials recommended by the manufacturer. Retest and reinspect repaired areas. Apply fireproofing material to voids or damaged areas by hand-trowel, or by respraying.

3.6.3 Visual Inspections

Inspections shall be made by the certified independent laboratory prior to closure of concealed areas. These inspections may be phased, but shall not occur less than 5 working days prior to the enclosure of the fireproofing. Sprayed areas shall receive a final inspection. Fireproofed surfaces shall be inspected after mechanical, electrical, and other work in contact with fireproofing material has been completed and before sprayed material is covered. Any locations missing fireproofing shall be patched in accordance with the manufacturer's requirements.

3.6.4 Patching

Patch and repair damaged fireproofing. The patching material shall be the same as that specified for that area.

3.7 CLEANUP

Thoroughly clean surfaces not indicated to receive fireproofing of sprayed material within a 24 hour period after application.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 84 00

FIRESTOPPING

05/10, CHG 1: 08/13

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 REFERENCES
- 1.3 SEQUENCING
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Installer
 - 1.5.2 Inspector Qualifications
- 1.6 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

- 2.1 FIRESTOPPING SYSTEM
- 2.2 FIRESTOPPING MATERIALS
 - 2.2.1 Fire Hazard Classification
 - 2.2.2 Toxicity
 - 2.2.3 Fire Resistance Rating
 - 2.2.3.1 Through-Penetrations
 - 2.2.3.1.1 Penetrations of Fire Resistance Rated Walls and Partitions
 - 2.2.3.1.2 Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the Ceiling Membrane of Roof-Ceiling Assemblies
 - 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
 - 2.2.3.2 Construction Joints and Gaps
 - 2.2.4 Material Certification

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 INSTALLATION
 - 3.2.1 Insulated Pipes and Ducts
 - 3.2.2 Fire Dampers
 - 3.2.3 Data and Communication Cabling
 - 3.2.3.1 Re-Enterable Devices
 - 3.2.3.2 Re-Sealable Products
- 3.3 INSPECTION
 - 3.3.1 Inspection Standards
 - 3.3.2 Inspection Reports

-- End of Section Table of Contents --

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; firestopping material shall not interfere with the required movement of the joint.

Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E119	(2020) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM 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	(2021) 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. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" 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

Firestopping System; G

SD-03 Product Data

Firestopping Materials; G

SD-06 Test Reports

Inspection; G

SD-07 Certificates

Inspector Qualifications
Firestopping Materials
Installer Qualifications; G

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 shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer and submit written certification of training, and retain proof of certification for duration of firestop installation.

1.5.2 Inspector Qualifications

The inspector shall meet the criteria contained in ASTM E699 for agencies involved in quality assurance and shall have a minimum of two years experience in construction field inspections of firestopping systems, products, and assemblies. The inspector shall be completely independent of, and divested from, the installer, the manufacturer, and the supplier of any material or item being inspected. The inspector shall not be a competitor of the installer, the contractor, the manufacturer, or supplier of any material or item being inspected. Include in the qualifications submittal a notarized statement assuring compliance with the requirements stated herein.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements and temperatures in accordance with manufacturer requirements. Remove damaged or deteriorated materials from the site. Use materials within their indicated shelf life.

PART 2 PRODUCTS

2.1 FIRESTOPPING SYSTEM

Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal must indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

Also, submit a written report indicating locations of and types of penetrations and types of firestopping used at each location; record type by UL list printed numbers.

2.2 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.2.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.2.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment.

2.2.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

2.2.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SUMMARY, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479. Fire resistance ratings shall be as follows:

2.2.3.1.1 Penetrations of Fire Resistance Rated Walls and Partitions

F Rating = hour; 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

Where the penetrating item is outside of a wall cavity the F rating must be equal to the fire resistance rating of the floor penetrated, and the T rating shall be in accordance with the requirements of ICC IBC.

2.2.3.1.3 Penetrations of Fire and Smoke Resistance Rated Walls, Floors, Floor-Ceiling Assemblies, and the ceiling membrane of Roof-Ceiling Assemblies

F Rating = Rating of wall or partition being penetrated and L Rating = <10 cfm/sf Where L rating is required.

2.2.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SUMMARY, and gaps such as those between floor slabs and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E119, ASTM E1966 or UL 2079 to meet the required fire resistance rating. Curtain wall joints shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E2307 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E1399/E1399M or UL 2079. All joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

2.2.4 Material Certification

Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification of compliance with UL 1479.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping must be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement must be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction must be capable of supporting the same load as the floor is designed to support or be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
- d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
- e. Construction joints in floors and fire rated walls and partitions.
- f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION. Firestop installed with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products.

3.2.3.1 Re-Enterable Devices

Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants; while maintaining "L" rating of <10 cfm/sf measured at ambient temperature and 400 degrees F at 0 percent to 100 percent visual fill.

3.2.3.2 Re-Sealable Products

Provide firestopping pre-manufactured modular products, containing self-sealing intumescent inserts. Firestopping products shall allow for cable moves, additions or changes. Devices shall be capable of maintaining the fire resistance rating of the penetrated membrane at 0 percent to 100 percent visual fill of penetrants.

3.3 INSPECTION

For all projects, the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the Contracting Officer. The inspector must inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.3.1 Inspection Standards

Inspect all firestopping in accordance with ASTM E2393 and ASTM E2174 for firestop inspection, and document inspection results to be submitted.

3.3.2 Inspection Reports

Submit inspection report stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 92 00

JOINT SEALANTS

08/16, CHG 3: 11/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 PRODUCT DATA
- 1.4 CERTIFICATIONS
 - 1.4.1 Indoor Air Quality Certifications
 - 1.4.1.1 Adhesives and Sealants
- 1.5 ENVIRONMENTAL CONDITIONS
- 1.6 DELIVERY AND STORAGE
- 1.7 QUALITY ASSURANCE
 - 1.7.1 Compatibility with Substrate
 - 1.7.2 Joint Tolerance
 - 1.7.3 Mock-Up
 - 1.7.4 Adhesion

PART 2 PRODUCTS

- 2.1 SEALANTS
 - 2.1.1 Interior Sealants
 - 2.1.2 Exterior Sealants
 - 2.1.3 Floor Joint Sealants
 - 2.1.4 Acoustical Sealants
 - 2.1.5 Preformed Sealants
 - 2.1.5.1 Foam Strip
- 2.2 PRIMERS
- 2.3 BOND BREAKERS
- 2.4 BACKSTOPS
 - 2.4.1 Rubber (Interior Use Only)
 - 2.4.2 PVC (Interior Use Only)
 - 2.4.3 Synthetic Rubber
 - 2.4.4 Neoprene
 - 2.4.5 Butyl Rubber Based (Exterior Use Only)
 - 2.4.6 Silicone Rubber Base (Interior Use Only)
- 2.5 CAULKING
- 2.6 CLEANING SOLVENTS

PART 3 EXECUTION

- 3.1 FIELD QUALITY CONTROL
- 3.2 SURFACE PREPARATION
 - 3.2.1 Steel Surfaces
 - 3.2.2 Aluminum or Bronze Surfaces
 - 3.2.3 Concrete and Masonry Surfaces
 - 3.2.4 Wood Surfaces
- 3.3 SEALANT PREPARATION

3.4 APPLICATION

- 3.4.1 Joint Width-To-Depth Ratios
- 3.4.2 Unacceptable Sealant Use
- 3.4.3 Masking Tape
- 3.4.4 Backstops
- 3.4.5 Primer
- 3.4.6 Bond Breaker
- 3.4.7 Sealants

3.5 PROTECTION AND CLEANING

- 3.5.1 Protection
- 3.5.2 Final Cleaning

-- End of Section Table of Contents --

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 C509	(2006; R 2021) Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C734	(2015; R 2019) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C919	(2012; R 2017) Standard Practice for Use of Sealants in Acoustical Applications
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1193	(2013) Standard Guide for Use of Joint Sealants
ASTM C1311	(2014) Standard Specification for Solvent Release Agents
ASTM C1521	(2013) Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
ASTM D217	(2019b) Standard Test Methods for Cone Penetration of Lubricating Grease
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1667	(2017) Standard Specification for Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D2452	(2015; R 2019) Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
ASTM D2453	(2015; R 2020; E 2020) Standard Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E90 (2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

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 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

Sealants; G

Primers; G

Bond Breakers; G

Backstops; G

SD-06 Test Reports

Field Adhesion; G

SD-07 Certificates

Indoor Air Quality For Interior Sealants; S

Indoor Air Quality For Interior Floor Joint Sealants; S

Indoor Air Quality For Interior Acoustical Sealants; S

Indoor Air Quality For Interior Caulking; S

1.3 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) and 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.	Match darker of adjacent surface color
b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.	Match darker of adjacent surface color
c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.	Match darker of adjacent surface color

LOCATION	COLOR
d. Joints between edge members for acoustical tile and adjoining vertical surfaces.	Match darker of adjacent surface color
e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	Match darker of adjacent surface color
f. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where non-planar tile surfaces meet.	Match color of grout
g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.	Match color of grout

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 darker of adjacent surface color
b. Masonry joints where shelf angles occur.	Match adjacent surface color
c. Joints in wash surfaces of stonework.	Match adjacent grout color
d. Expansion and control joints.	Match adjacent surface color
e. Voids where items pass through exterior walls.	Match adjacent surface color
f. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.	Match adjacent grout color
g. Metal-to-metal joints where sealant is indicated or specified.	Match adjacent surface color

LOCATION	COLOR
h. Joints between ends of gravel stops, fascia, copings, and adjacent walls.	Match adjacent surface color

2.1.1.3 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.	Gray
b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.	Gray, match adjacent grout color at tile color

2.1.1.4 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) and VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior acoustical sealants.

ASTM E90, Class 12.5, provide acrylic latex sealant for use in smoke rated partitions or joints and to prevent sound transmission through unprotected openings. Application temperature must be 40 degrees F to 104 degrees F. Not for use in fire-rated applications. Color: white.

2.1.1.5 Preformed Sealants

Provide preformed sealants of polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealants capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 30 to plus 160 degrees F, sealants must be non-bleeding and have no loss of adhesion.

2.1.5.1 Foam Strip

Provide closed cell foam strip of polyurethane foam with cross section size required for snug fit in cavity. Provide foam strip capable of sealing out moisture, air, and dust when installed and compressed in accordance with manufacturer's printed instructions. Service temperature must be minus 40 to plus 275 degrees F. Furnish untreated strips with adhesive to hold them in place. Do not allow adhesive to stain or bleed onto adjacent finishes. Saturate treated strips with butylene waterproofing or impregnate with asphalt.

2.2 PRIMERS

Non-staining, quick drying type and consistency as recommended by the sealant manufacturer for the particular application. Provide primers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.3 BOND BREAKERS

Type and consistency as recommended by the sealant manufacturer to prevent adhesion of the sealant to the backing or to the bottom of the joint. Provide bond breakers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.4 BACKSTOPS

Provide glass fiber roving, neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Provide backstop material that is compatible with sealant. Do not use oakum or other types of absorptive materials as backstops.

2.4.1 Rubber (Interior Use Only)

Provide in accordance with ASTM D1056, Type 2, closed cell, Class A, round cross section for cellular rubber sponge backing as required.

2.4.2 PVC (Interior Use Only)

Provide in accordance with ASTM D1667, Grade VO 12, open-cell foam, round cross section for polyvinyl chloride (PVC) backing.

2.4.3 Synthetic Rubber

Provide in accordance with ASTM C509, Option I , Type I preformed rods for synthetic rubber backing.

2.4.4 Neoprene

Provide in accordance with ASTM D1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 open cell neoprene sponge Type 1, Class C, Grade 1C3 for neoprene backing.

2.4.5 Butyl Rubber Based (Exterior Use Only)

Provide in accordance with ASTM C1311, from a single component, with

solvent release. color as selected from manufacturer's full range of color choices.

2.4.6 Silicone Rubber Base (Interior Use Only)

Provide in accordance with ASTM C920, from a single component, with solvent release, Non-sag, Type S, Grade NS/SL, Class 100/50. Color as selected from manufacturer's full range of color choices.

2.5 CAULKING

For interior use and only where there is little or no anticipated joint movement. Provide in accordance with ASTM D2452 and ASTM D2453, Type S, for oil and resin-based caulking. Provide products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior caulking.

2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer and in accordance with environmental requirements herein. Protect adjacent aluminum and bronze surfaces from solvents. Provide solvents for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

Perform a field adhesion test in accordance with manufacturer's instructions and ASTM C1193, Method A or ASTM C1521, Method A, Tail Procedure. Remove sealants that fail adhesion testing; clean substrates, reapply sealants, and re-test. Test sealants adjacent to failed sealants. Submit field adhesion test report indicating tests, locations, dates, results, and remedial actions taken.

3.2 SURFACE PREPARATION

Prepare surfaces according to manufacturer's printed installation instructions. Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would destroy or impair adhesion. Remove oil and grease with solvent; thoroughly remove solvents prior to sealant installation. Wipe surfaces dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, provide in accordance with sealant manufacturer's printed instructions for each specific surface.

3.2.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finished work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue free solvent. Remove resulting debris and solvent residue prior to sealant installation.

3.2.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.2.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity. Remove resulting debris prior to sealant installation.

3.2.4 Wood Surfaces

Ensure wood surfaces that will be in contact with sealants are free of splinters, sawdust and other loose particles.

3.3 SEALANT PREPARATION

Do not add liquids, solvents, or powders to sealants. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.4 APPLICATION

3.4.1 Joint Width-To-Depth Ratios

Acceptable Ratios:

<u>JOINT WIDTH</u>	<u>JOINT DEPTH</u>	
	Minimum	Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, 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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 11 13

STEEL DOORS AND FRAMES

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

- 2.1 STANDARD STEEL DOORS
 - 2.1.1 Classification - Level, Performance, Model
 - 2.1.1.1 Extra Heavy Duty Doors
- 2.2 INSULATED STEEL DOOR SYSTEMS
- 2.3 SOUND RATED STEEL DOORS
- 2.4 ACCESSORIES
 - 2.4.1 Louvers
 - 2.4.1.1 Interior Louvers
 - 2.4.1.2 Exterior Louvers
 - 2.4.2 Astragals
 - 2.4.3 Moldings
- 2.5 INSULATION CORES
- 2.6 STANDARD STEEL FRAMES
 - 2.6.1 Welded Frames
 - 2.6.2 Stops and Beads
 - 2.6.3 Anchors
 - 2.6.3.1 Wall Anchors
 - 2.6.3.2 Floor Anchors
- 2.7 FIRE AND SMOKE DOORS AND FRAMES
 - 2.7.1 Labels
 - 2.7.2 Oversized Doors
 - 2.7.3 Astragal on Fire and Smoke Doors
- 2.8 EXTERIOR FRAMES
- 2.9 HARDWARE PREPARATION
- 2.10 FINISHES
 - 2.10.1 Factory-Primed Finish
 - 2.10.2 Hot-Dip Zinc-Coated and Factory-Primed Finish
 - 2.10.3 Electrolytic Zinc-Coated Anchors and Accessories
 - 2.10.4 Factory-Applied Enamel Finish
- 2.11 FABRICATION AND WORKMANSHIP
- 2.12 PROVISIONS FOR GLAZING

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Frames
 - 3.1.2 Doors
 - 3.1.3 Fire and Smoke Doors and Frames

Joint Cryptologic Center Building - Buckley SFB, CO

BU81

3.2 PROTECTION

3.3 CLEANING

-- End of Section Table of Contents --

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) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M (2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A879/A879M (2012; R 2017) Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

ASTM A924/A924M (2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM C578 (2019) Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation

ASTM C591 (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)

ASTM F2247 (2018) Standard Test Method for Metal Doors Used in Blast Resistant Applications (Equivalent Static Load Method)

ASTM F2927 (2012) Standard Test Method for Door Systems Subject to Airblast Loadings

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115 (2016) Hardware Preparation in Steel Doors and Steel Frames

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (2019) Standard for Fire Doors and Other Opening Protectives

NFPA 105 (2019) Standard for Smoke Door Assemblies and Other Opening Protectives

NFPA 252 (2017) 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 A250.3 (2019) Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames

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

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01 (2018;with Change 1, 2020) DoD Minimum Antiterrorism Standards for Buildings

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 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

Doors; G

Frames; G

Accessories

Schedule of Doors; G

Schedule of Frames; G

SD-03 Product Data

Doors; G

Recycled Content for Steel Door Product; S

Frames; G

Recycled Content for Steel Frame Product; S

Accessories

SD-04 Samples

Factory-applied Enamel Finish; G

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. Exterior doors must be tested in accordance with ASTM F2247 or ASTM F2927 to meet requirements of UFC 4-010-01.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Extra Heavy Duty Doors

SDI/DOOR A250.8, Level 3, physical performance Level A, Model 2 with core construction as required by the manufacturer for interior doors and for indicated 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. Provide Level 3 where indicated.

2.2 INSULATED STEEL DOOR SYSTEMS

Provide insulated steel doors and frames in accordance with SDI/DOOR 113 at entrances to dwelling units and where indicated. Meet energy requirements including Solar Heat Gain Coefficient (SHGC) and U-factor. Provide insulated steel doors with a core of polyurethane foam; face sheets, edges, and frames of galvanized steel not lighter than 23 gage, 16 gage, and 16 gage respectively; magnetic weatherstripping; nonremovable-pin hinges; thermal-break aluminum threshold; and vinyl door bottom. Provide to doors and frames a phosphate treatment, rust-inhibitive primer, and baked acrylic enamel finish. Test doors in accordance with SDI/DOOR A250.4 and meet the requirements for Level C. Prepare doors to receive specified hardware. Provide doors 1-3/4 inch thick.

2.3 SOUND RATED STEEL DOORS

Provide sound rated doors with a Sound Transmission Class (STC) as indicated on the drawings and as specified in Section 08 34 73 SOUND CONTROL DOOR ASSEMBLIES.

2.4 ACCESSORIES

2.4.1 Louvers

2.4.1.1 Interior Louvers

SDI/DOOR 111. Where indicated, provide louvers of stationary type where scheduled. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 20 gage steel and louver blades of a minimum 24 gage.

2.4.1.2 Exterior Louvers

Provide louvers of the inverted "Z" type with minimum of 50 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. At louvers provide steel-framed insect screens secured to room side and readily removable. Provide aluminum wire cloth, 18 by 18 or 18 by 16 inch mesh, for insect screens. Net-free louver area to be before screening.

2.4.2 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.

2.4.3 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.

2.5 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 .42 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.

2.6 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, 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.

2.6.1 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.

2.6.2 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.

2.6.3 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated not lighter than 18 gage.

2.6.3.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;
- b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;
- c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and
- d. Solid plaster partitions: Secure anchors solidly to back of frames and tie into the lath. Provide adjustable top strut anchors on each side of frame for fastening to structural members or ceiling construction above. Provide size and type of strut anchors as recommended by the frame manufacturer.

2.6.3.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member. Where floor fill occurs, terminate bottom of frames at the indicated finished floor levels and support by adjustable extension clips resting on and anchored to the structural slabs.

2.7 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.

2.7.1 Labels

Provide fire doors and frames bearing the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing must be in accordance with NFPA 252 or UL 10C. Provide labels that are metal with raised letters, bearing the name or file number of the door and frame manufacturer. Labels must be permanently affixed at the factory to frames and to the hinge edge of the door. Do not paint door and labels.

2.7.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

2.7.3 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.

2.8 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.

2.9 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 or lightproof or 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.

2.10 FINISHES

2.10.1 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.

2.10.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior scheduled 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.

2.10.3 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.

2.10.4 Factory-Applied Enamel Finish

Provide coatings that meet test procedures and acceptance criteria in accordance with SDI/DOOR A250.3. After factory priming, apply two coats of medium-gloss enamel to exposed surfaces. Separately bake or oven dry each coat. Drying time and temperature requirements must be in accordance with the coating manufacturer's recommendations. Provide finish coat color(s) as indicated.

2.11 FABRICATION AND WORKMANSHIP

Provide finished doors and frames that are strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Provide molded members that are clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints must be well formed and in true alignment. Conceal fastenings where practicable. On wraparound frames for masonry partitions, provide a throat opening 1/8 inch larger than the actual masonry thickness. Design

other frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

2.12 PROVISIONS FOR GLAZING

Materials are specified in Section 08 81 00, GLAZING.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 11 16

ALUMINUM DOORS AND FRAMES

05/17, CHG 2: 11/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 PERFORMANCE REQUIREMENTS
 - 1.2.1 Structural Calculations
 - 1.2.1.1 Minimum Antiterrorism Performance
 - 1.2.2 Air Infiltration
 - 1.2.3 Water Penetration
 - 1.2.4 Thermal Transmittance, Solar Heat Gain, Visible Light Transmittance
 - 1.2.4.1 U-Factor
 - 1.2.4.2 Solar Heat Gain Coefficient (SHGC)
 - 1.2.4.3 Visible Light Transmittance (VLT)
- 1.3 SUBMITTALS
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 QUALITY CONTROL
 - 1.5.1 Shop Drawing
 - 1.5.2 Finish Samples
 - 1.5.3 Operation and Maintenance Data
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Engineer Qualifications for Blast Design

PART 2 PRODUCTS

- 2.1 DOORS AND FRAMES
- 2.2 MATERIALS
 - 2.2.1 Anchors
 - 2.2.2 Weatherstripping
 - 2.2.3 Aluminum Alloy for Doors and Frames
 - 2.2.4 Fasteners
 - 2.2.5 Structural Steel
 - 2.2.6 Aluminum Paint
- 2.3 FABRICATION
 - 2.3.1 Aluminum Frames
 - 2.3.2 Aluminum Doors
 - 2.3.2.1 Full Glazed Stile and Rail Doors
 - 2.3.2.2 Flush Doors
 - 2.3.3 Welding and Fastening
 - 2.3.4 Weatherstripping
 - 2.3.5 Anchors
 - 2.3.6 Provisions for Hardware
 - 2.3.7 Provisions for Glazing
 - 2.3.8 Finishes
 - 2.3.8.1 Organic Coating

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 PROTECTION FROM DISSIMILAR MATERIALS
 - 3.2.1 Dissimilar Metals
 - 3.2.1.1 Protection
 - 3.2.2 Drainage from Dissimilar Metals
 - 3.2.3 Masonry and Concrete
 - 3.2.4 Wood or Other Absorptive Materials
- 3.3 SEALING AROUND ASSEMBLIES
- 3.4 CLEANING
- 3.5 PROTECTION

-- End of Section Table of Contents --

SECTION 08 11 16

ALUMINUM DOORS AND FRAMES

05/17, CHG 2: 11/18

PART 1 GENERAL

1.1 REFERENCES

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

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 1-4 2020;
Interpretation 5-8 2021; Addenda AS-CB
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

ASTM F2248

(2012) Standard Practice for Specifying an
Equivalent 3-Second Duration Design
Loading for Blast Resistant Glazing
Fabricated with Laminated Glass

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100

(2017) Procedure for Determining
Fenestration Product U-Factors

NFRC 200

(2017) Procedure for Determining
Fenestration Product Solar Heat Gain
Coefficient and Visible Transmittance at
Normal Incidence

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Structural Calculations

1.2.1.1 Minimum Antiterrorism Performance

Provide doors meeting the minimum antiterrorism performance as specified in the paragraphs below.

- a. Aluminum Doors: Must meet the minimum DOD standard 3-11.1 Glazing in UFC 4-010-01. For glazing in exterior building elements such as storefronts, doors, windows, curtain walls, clerestories, provide a glazing frame bite in accordance with ASTM F2248

1.2.2 Air Infiltration

When tested in accordance with ASTM E283, air infiltration per door leaf cannot exceed 0.6 cubic feet per minute per square foot of fixed area at a test pressure of 6.24 pounds per square foot.

1.2.3 Water Penetration

When tested in accordance with ASTM E331, there can be no water penetration at a pressure of 2.86 pounds per square foot of fixed area.

1.2.4 Thermal Transmittance, Solar Heat Gain, Visible Light Transmittance

Provide products bearing NFRC Project Label Certificates for Fenestration verifying compliance with requirements for each assembly indicated. An NFRC Bid Report, or approved equal, for field assembled exterior doors may be submitted in lieu of Project Label Certificates for Fenestration if such reports are created in accordance with NFRC CAMP procedures and are provided by the manufacturer. Such alternate reports may be submitted with shop drawings, however, NFRC validated Project Label Certificates for Fenestration are required as a Closeout Submittal. Contact NFRC for information on NFRC 100 and NFRC 200 Compliance and Monitoring Program (CAMP) rating requirements:

<http://www.nfrc.org/industry/certification/compliance-and-monitoring-program-camp/>

1.2.4.1 U-Factor

Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified by the NFRC as having a whole window U-factor of 0.42 or less as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 100.

1.2.4.2 Solar Heat Gain Coefficient (SHGC)

Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified by the National Fenestration Rating Council with a whole window SHGC of 66 frames and 60 glass or less as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 200.

1.2.4.3 Visible Light Transmittance (VLT)

Provide exterior glazed assemblies, including aluminum entrances doors with greater than 50 percent glazed area, certified by the NFRC with a whole window VLT of 0.6 or greater as determined in accordance with ASHRAE 90.1 - IP and as verified in accordance with NFRC 200.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

For Each Type of Door and Frame Assembly; G

SD-03 Product Data

For Each Type of Door and Frame Assembly; G

Recycled Content of Aluminum Material; S

SD-04 Samples

Finish Samples; G

SD-05 Design Data

Structural Calculations for Deflection and Antiterrorism; G

SD-06 Test Reports

Air Infiltration; G

Water Penetration; G

SD-07 Certificates

NFRC Project Label Certificates for Fenestration; G

SD-08 Manufacturer's Instructions

Installation of Each Type of Door and Frame Assembly; G

SD-10 Operation and Maintenance Data

Adjustments, Cleaning, and Maintenance; G

SD-11 Closeout Submittals

NFRC Project Label Certificates for Fenestration; G

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. A qualified blast engineer must perform testing or calculations for door system design resistance to specified blast loads.

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.

1.6 QUALITY ASSURANCE

1.6.1 Engineer Qualifications for Blast Design

All blast design calculations must be performed by or under the direct supervision of a registered engineer with a minimum of 5 years' experience performing blast design. The engineering firm performing the blast design must be able to demonstrate experience on similar size projects using similar design methods to meet the requirements outlined in this specification.

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, subframes, transoms, adjoining side lites, trim, and accessories. Coordinate side lites, window walls, adjacent curtainwall with Section 08 44 00 CURTAIN WALL AND GLAZED ASSEMBLIES.

2.2 MATERIALS

2.2.1 Anchors

Stainless steel.

2.2.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

2.2.3 Aluminum Alloy for Doors and Frames

ASTM B221M, ASTM B221, Alloy 6063-T5 for extrusions. ASTM B209M, ASTM B209, alloy and temper best suited for aluminum sheets and strips. Provide aluminum materials that include a minimum of 30 percent recycled content. Provide data indicating percentage of recycled content of aluminum material.

2.2.4 Fasteners

Hard aluminum or stainless steel.

2.2.5 Structural Steel

ASTM A36/A36M.

2.2.6 Aluminum Paint

Aluminum door manufacturer's standard aluminum paint.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 12 inches on center. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically.

2.3.2 Aluminum Doors

Of type, size, and design indicated and minimum 1-3/4 inch thick. minimum wall thickness, 0.125 inch, except beads and trim, 0.050 inch. Door sizes shown are nominal; include standard clearances as follows: 0.093 inch at hinge and lock stiles, 0.125 inch between meeting stiles, 0.125 inch at top rails, 0.187 inch between bottom and threshold, and 0.687 inch between bottom and floor. Provide bevel single-acting doors 0.063 or 0.125 inch at lock, hinge, and meeting stile edges.

2.3.2.1 Full Glazed Stile and Rail Doors

Provide doors with narrow stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 3/8 or 1/2 inch diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

2.3.2.2 Flush Doors

Use facing sheets with a plain smooth surface. Use one of the following constructions:

- a. A phenolic resin-impregnated kraft paper honeycomb core, surrounded at edges and around glass and louvered areas with extruded aluminum shapes. Provide cores with a minimum impregnation of 18 percent resin content. Provide sheet aluminum door facings minimum 0.032 inch thick laminated to a 0.10 inch thick tempered hardboard backing, with the backing bonded to the honeycomb core. Bond facing sheets to cores under heat and pressure with thermosetting adhesive and mechanically lock to extruded edge members.
- b. A phenolic resin-impregnated kraft paper honeycomb core. Use aluminum facing sheets minimum 0.050 inch thick and form into two pans to eliminate seams on faces. Bond honeycomb core to face sheets using epoxy resin or contact cement-type adhesive.
- c. A solid fibrous core, surrounded at edges and around glass and louvered areas and cross braced at intermediate points with extruded aluminum shapes. Use aluminum facing sheets of minimum 0.050 inch thickness. Bond facing sheets to core under heat and pressure with a thermosetting adhesive, and mechanically lock to the extruded edge members.
- d. Form from extruded tubular stiles and rails mitered at corners, reinforce, and continuously weld at miters. Provide facing sheets of minimum 0.032 inch thick sheet aluminum internally reinforced with aluminum channels or Z-bars placed horizontally not more than 16 inch apart and extending the full width of panels. Fit spaces between reinforcing with sound-deadening insulation. Weld facing sheets to reinforcing bars or channels and to stiles and rails. Finish facing sheets flush with faces of stiles and rails.
- e. Form from an internal grid composed of extruded aluminum tubular sections. Provide tubular sections at all sides and perimeter of louver and glass openings. Provide three extruded aluminum tubular sections at top and bottom of each door. Provide wall thickness of tubular sections minimum 0.09 inch except at lock rails which must be minimum 0.125 inch thick, hinge lock rails which must be minimum 0.125 inch thick, and hinge rail edges which must be minimum 0.19 inch thick. Fill spaces in door with mineral insulation. Provide facing sheets of aluminum minimum 0.09 inch thick.
- f. Form from extruded aluminum members at top and bottom, both sides, and at perimeters of louver and glass openings. Provide wall sections of extruded aluminum members minimum 0.09 inch thick and reinforce for

application of hardware. Cover framing members on both sides with aluminum facing sheets minimum 0.064 inch thick. Fill door panels with 25 pounds per square inch density polystyrene with a flame spread rating of no more than 25.

2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and must have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots which are integral with doors or frames. Weatherstripping must be replaceable without special tools, and adjustable at meeting rails of pairs of doors. During installation, verify doors swing freely and close positively. Refer to paragraph AIR INFILTRATION for air leakage requirements and testing.

2.3.5 Anchors

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. Provide reinforcement in core of flush doors as required to receive locks, door closers, and other hardware.

2.3.7 Provisions for Glazing

Provide glazing beads with vinyl insert glazing gaskets. Design glazing beads to receive thickness indicated for each glazed assembly. Coordinate requirements with Section 08 81 00 GLAZING.

2.3.8 Finishes

Provide exposed aluminum surfaces with factory finish of 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.

PART 3 EXECUTION

3.1 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions and the approved shop drawings. Install anchorage that complies with applicable structural requirements. Anchor bottom of each frame to rough floor construction with 3/32 inch thick minimum stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Hang doors to produce clearances specified in paragraph ALUMINUM DOORS. After erection and glazing, adjust doors and hardware to operate properly.

3.2 PROTECTION FROM DISSIMILAR MATERIALS

3.2.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact to dissimilar metals.

3.2.1.1 Protection

Provide one of the following systems to protect surfaces in contact with dissimilar metals:

- a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.
- b. Apply elastomeric sealant between aluminum and dissimilar metals in accordance with Section 07 92 00 JOINT SEALANTS.
- c. Paint dissimilar metals with one coat of primer and one coat of aluminum paint.
- d. Use a non-absorptive tape or gasket in permanently dry locations.

3.2.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint to prevent aluminum discoloration.

3.2.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.2.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting aluminum, paint the wood or other absorptive surface with two coats of aluminum paint and seal joints with elastomeric sealant.

3.3 SEALING AROUND ASSEMBLIES

Seal all penetrations of the air barrier by sealing around door openings as necessary to achieve compliance with air leakage requirements indicated in the requirements of Section 07 27 10.00 10 BUILDING AIR BARRIER SYSTEM, and Section 07 05 23 PRESSURE TESTING AN AIR BARRIER SYSTEM FOR AIR TIGHTNESS. Flash all doors with corrosion resistant flashing to prevent water intrusion.

3.4 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's written recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.5 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 14 00

WOOD DOORS

08/16, CHG 1: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Certified Wood Grades
 - 1.3.2 Certified Sustainably Harvested Wood
 - 1.3.3 Indoor Air Quality Certification
 - 1.3.3.1 Composite Wood, Wood Structural Panel and Agrifiber Products
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 WARRANTY

PART 2 PRODUCTS

- 2.1 DOORS
 - 2.1.1 Stile and Rail Doors
 - 2.1.2 Flush Doors
 - 2.1.2.1 Interior Flush Doors
 - 2.1.3 Acoustical Doors
 - 2.1.4 Fire Doors
- 2.2 ACCESSORIES
 - 2.2.1 Door Light Openings
 - 2.2.2 Additional Hardware Reinforcement
- 2.3 FABRICATION
 - 2.3.1 Marking
 - 2.3.2 Quality and Construction
 - 2.3.3 Preservative Treatment
 - 2.3.4 Adhesives and Bonds
 - 2.3.5 Prefitting
 - 2.3.6 Finishes
 - 2.3.6.1 Field Painting
 - 2.3.6.2 Factory Finish
 - 2.3.6.3 Color
 - 2.3.7 Water-Resistant Sealer
- 2.4 SOURCE QUALITY CONTROL

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Fire and Smoke Doors

-- End of Section Table of Contents --

SECTION 08 14 00

WOOD DOORS

08/16, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E90	(2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
----------	---

ASTM E2226	(2015; R 2019b) Standard Practice for Application of Hose Stream
------------	--

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	(2019) Standard for Fire Doors and Other Opening Protectives
---------	--

NFPA 105	(2019) Standard for Smoke Door Assemblies and Other Opening Protectives
----------	---

NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies
----------	--

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)

PEFC ST 2002:2020	(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
---------------	--

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 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

Doors; G

Submit drawings or catalog data showing each type of door unit ; include descriptive data of head and jamb weatherstripping with installation instructions. Indicate within drawings and data the door types and construction, sizes, thickness, methods of assembly, door louvers, and glazing,.

SD-03 Product Data

Doors; G

Recycled Content for Door Cores; S

Accessories

Water-resistant Sealer

Sample Warranty

Sound Transmission Class Rating; G

Fire Resistance Rating; G

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

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 Stile and Rail Wood Doors; S

Certified Sustainably Harvested Flush Wood Doors; S

Indoor Air Quality for Particleboard and Agrifiber Door Cores: S

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 doors certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08(R2013), SFI 2015-2019, or other third-party program certified by PEFC ST 2002:2020. 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 product data for certified sustainably harvested stile and rail wood doors and certified sustainably harvested flush wood doors.

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, biobased and virgin wood door substrates. Provide products certified to meet requirements of either California Air Resources Board (CARB) regulation Airborne Toxic Control Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products or California

Department of Public Health (CDPH) Standard Method. Submit product data for indoor air quality for particleboard and agrifiber door cores.

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 and specified free of urea-formaldehyde resins.

2.1.1 Stile and Rail Doors

Premium grade Ponderosa Pine doors or premium or select stile and rail doors conforming to ANSI/WDMA I.S.6A. Furnish laminate panels in not less than three ply thickness. Provide flat panels with a minimum finished panel thickness of 1/2 inch and 3/4 inch thickness for raised panels. Provide certified sustainably harvested stile and rail wood doors.

2.1.2 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.

2.1.2.1 Interior Flush Doors

Provide particleboard core, Type II flush doors conforming to ANSI/WDMA I.S.1A with faces of select premium white birch. Hardwood veneers must be rotary cut, random matched. Door cores must have a minimum recycled content of 45 percent. Provide data identifying percentage of recycled content for door cores. Products must contain no added urea-formaldehyde resins. Provide certification of indoor air quality for particleboard and agrifiber door cores.

2.1.3 Acoustical Doors

ANSI/WDMA I.S.1A, solid core, constructed to provide Sound Transmission Class rating of 30 or 50, as indicated, when tested in accordance with ASTM E90.

2.1.4 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

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 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 Field Painting

Factory prime or seal doors, and field paint.

2.3.6.2 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, closed 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.

2.3.6.3 Color

Provide door finish colors in accordance with the finish schedule on the drawings.

2.3.7 Water-Resistant Sealer

Provide manufacturer's standard water-resistant sealer compatible with the specified finishes.

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 --

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 31 00

ACCESS DOORS AND PANELS

05/17, CHG 1: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 MISCELLANEOUS REQUIREMENTS
 - 1.3.1 Shop Drawings
 - 1.3.2 Product Data
 - 1.3.3 Finish Samples
 - 1.3.4 Test Reports
- 1.4 PERFORMANCE REQUIREMENTS
 - 1.4.1 Structural Requirements
 - 1.4.2 Acoustical Requirements
 - 1.4.3 Fire-Rating Requirements
 - 1.4.4 Insulated Access Panels
 - 1.4.5 Access Panels for Wet Areas
- 1.5 DELIVERY, STORAGE, AND PROTECTION

PART 2 PRODUCTS

- 2.1 RECYCLED CONTENT
- 2.2 MATERIALS
 - 2.2.1 Steel Plates, Shapes, and Bars
 - 2.2.2 Sheet Steel
 - 2.2.3 Stainless Steel
 - 2.2.4 Metallic Coated Steel Sheet
 - 2.2.5 Hardware
 - 2.2.6 Hinges
 - 2.2.7 Locks
 - 2.2.8 Accessories
- 2.3 FABRICATION
 - 2.3.1 Thickness, Size, Edges
 - 2.3.2 Welding
- 2.4 ACCESS ASSEMBLY TYPES
 - 2.4.1 Recessed Doors
 - 2.4.2 Fire-rated Doors
 - 2.4.2.1 Door Construction
 - 2.4.2.2 Labels
 - 2.4.2.3 Door Panel and Frame
 - 2.4.3 Acoustical Doors
 - 2.4.4 Insulated Doors
- 2.5 FINISHES

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 GENERAL INSTALLATION REQUIREMENTS

- 3.3 ACCESS LOCATIONS
- 3.4 ACCESS LOCATIONS IN WET AREAS
- 3.5 RECESSED ACCESS DOORS
- 3.6 FIELD PAINTING
- 3.7 DISSIMILAR MATERIALS
- 3.8 ADJUSTMENT
- 3.9 ENVIRONMENTAL CONDITIONS

-- 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) 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 (2020) 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 (2016) 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 80	(2019) Standard for Fire Doors and Other Opening Protectives
NFPA 252	(2017) 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 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

Access Doors And Panels; G

SD-03 Product Data

Access Doors And Panels; G

Hardware Including Locks and Keys; G

Accessories; G

Power Transfer Components; G

Recycled Content; S

SD-04 Samples

Finishes; G

SD-06 Test Reports

Fire-rating(s) of Assemblies; G

Acoustical Ratings of Assemblies; G

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 and locations and power transfer components for electrified locks and alarms.

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, fire-ratings of assemblies, and locations and power transfer components for electrified locks and alarms.. 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) as indicated on the Drawings in accordance with the adjacent partition or ceiling rating it is installed to. Provide gasketing in accordance with manufacturer's written recommendations.

1.4.3 Fire-Rating Requirements

Provide access panels with a minimum fire-rating of as indicated on the Drawings in accordance with the adjacent partition or ceiling rating it is

installed to.

1.4.4 Insulated Access Panels

Provide panels in a thickness as necessary to achieve a minimum R-value of as indicated on the Drawings in accordance with the adjacent partition or ceiling rating it is installed to. Provide gasketing as necessary for an airtight installation.

1.4.5 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. Lock cylinders are specified in Section 08 71 00 DOOR HARDWARE.

2.2.8 Accessories

Provide anchors in size, number and location on four sides to secure access door to substrate. Provide anchors in types as recommended by manufacturer's written installation instructions for each substrate indicated. Provide shims, bushings, clips, gaskets, and other devices as necessary for a complete installation.

2.3 FABRICATION

2.3.1 Thickness, Size, Edges

Fabricate frames for access doors of steel not lighter than 16 gage with welded joints and anchorage for securing to adjacent construction. Provide doors a minimum of 24 by 24 inches and of not lighter than 16 gage steel, with stiffened edges and welded attachments. Provide with eased (lightly rounded) edges, without burrs, snags or sharpness and exposed welds ground smooth.

2.3.2 Welding

Provide in accordance with AWS D1.1/D1.1M.

2.4 ACCESS ASSEMBLY TYPES

Unless indicated otherwise, provide flush-face steel access doors and panels with steel frames and flanges.

2.4.1 Recessed Doors

Provide recessed access doors with gypsum wallboard bead flanges. Depth of door panel recess must accommodate the installed thickness of the finish material of the wall assembly for a flush finished condition of the wall and the access panel face. Reinforce panel and frame to prevent sagging.

2.4.2 Fire-rated Doors

2.4.2.1 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.

2.4.2.2 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.

2.4.2.3 Door Panel and Frame

Steel sheet, with mineral fiber insulation core, insulated sandwich type construction.

2.4.3 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.

2.4.4 Insulated Doors

Provide access door panels with 25 pounds per square inch density polystyrene with a flame spread rating of no more than 25.

2.5 FINISHES

Provide steel frames and panel surfaces with a powder coated finish. 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 steel frame and panel surfaces with a shop applied prime coat. Field paint frames and panels to match wall and ceiling surfaces in which they occur. Provide exposed fastenings that approximately match the color and finish of the each material to which fastenings are applied.

PART 3 EXECUTION

3.1 PREPARATION

Field verify all measurements prior to fabrication. Verify access door locations and sizes provide required maintenance access to installed building services components. Protect existing construction and completed work from damage during installation.

3.2 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, in accordance with manufacturer's written instructions. Include materials and parts as necessary for a complete installation of each item. Conceal fastenings where practicable. Poor matching of holes to fasteners is cause for rejection of the work.

3.3 ACCESS LOCATIONS

Install removable access panels directly below each valve, flow indicator, damper, air splitter or other utility requiring access that is located above ceilings, other than at acoustical panel ceilings, and that would otherwise not be accessible. Install access doors and panels permitting access to service valves, traps, dampers, cleanouts, and other mechanical, electrical and conveyor control items concealed in walls and partitions.

3.4 ACCESS LOCATIONS IN WET AREAS

When possible, avoid locating access panels in wet areas. When such locations cannot be avoided, provide moisture resistant assemblies as indicated in Part I herein.

3.5 RECESSED ACCESS DOORS

Install fire-rated access doors in fire-rated partitions and ceilings in accordance with NFPA 80.

3.6 FIELD PAINTING

Field painting primed access doors in accordance with the requirements of Section 09 90 00 PAINTS AND COATINGS.

3.7 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, protect surfaces with a coating in accordance with MPI 79 to prevent galvanic or corrosive action.

3.8 ADJUSTMENT

Adjust hardware so that door panel opens freely. Adjust door when closed center door panel in frame.

3.9 ENVIRONMENTAL CONDITIONS

Do not paint surfaces when damp or exposed to weather, when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the Contracting Officer.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 34 73

SOUND CONTROL DOOR ASSEMBLIES

11/19, CHG 1: 02/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality Certifications
 - 1.3.1.1 Composite Wood Doors
- 1.4 QUALITY CONTROL
 - 1.4.1 Compliance and Labeling
 - 1.4.1.1 Compliance with Accessibility Requirements
 - 1.4.1.2 Category A Positive Pressure Fire Door Construction
 - 1.4.1.3 Category B Positive Pressure Fire Door Construction
 - 1.4.1.4 Labeling
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Design Requirements
 - 2.1.1.1 Door Design
 - 2.1.1.2 Frame Design
 - 2.1.2 Performance Requirements
 - 2.1.2.1 STC (Sound Transmission Classification) Rating
- 2.2 FABRICATION
 - 2.2.1 Hollow Metal Sound Retardant Doors
 - 2.2.1.1 Construction
 - 2.2.1.2 Coating
 - 2.2.2 Wood Sound Retardant Doors
 - 2.2.2.1 Faces
 - 2.2.3 Door Finishing
- 2.3 COMPONENTS
 - 2.3.1 Frames
 - 2.3.2 Door Frame Sound Infill
 - 2.3.3 Hardware Reinforcements
 - 2.3.4 Jamb Anchors
 - 2.3.4.1 Masonry Type
 - 2.3.4.2 Stud-Wall Type
 - 2.3.4.3 Post-installed Expansion Type
 - 2.3.5 Door Hardware
 - 2.3.6 Head and Jamb Seals
 - 2.3.7 Door Bottoms
 - 2.3.7.1 Automatic Door Bottoms
 - 2.3.8 Thresholds
 - 2.3.9 Astragals
- 2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

- 2.4.1 Sound Transmission Classification
- 2.4.2 Positive Pressure
- 2.4.3 Cam Lift Hinges
- 2.4.4 Guarantee

PART 3 EXECUTION

- 3.1 PREPARATION
 - 3.1.1 Frame Painting and Cleaning
- 3.2 INSTALLATION
 - 3.2.1 Frame
 - 3.2.2 Door
- 3.3 FIELD QUALITY CONTROL
 - 3.3.1 Testing and Performance

-- End of Section Table of Contents --

SECTION 08 34 73

SOUND CONTROL DOOR ASSEMBLIES

11/19, CHG 1: 02/21

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3/D1.3M	(2018) Structural Welding Code - Sheet Steel
----------------	--

ASTM INTERNATIONAL (ASTM)

ASTM A36/A36M	(2019) Standard Specification for Carbon Structural Steel
---------------	---

ASTM A108	(2013) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
-----------	--

ASTM A568/A568M	(2019a) Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
-----------------	---

ASTM A1008/A1008M	(2020) 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	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
------------	---

ASTM D6386	(2016a) Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
------------	---

ASTM E90	(2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E336	(2020) Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings
ASTM E413	(2016) Classification for Rating Sound Insulation
ASTM E1289	(2008; R 2016) Standard Specification for Reference Specimen for Sound Transmission Loss

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(2019) Standard for Fire Doors and Other Opening Protectives
NFPA 101	(2021) Life Safety Code
NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies

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 10C	(2016; Reprint May 2021) UL Standard for Safety Positive Pressure Fire Tests of Door Assemblies
--------	---

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 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

Fabrication Drawings

SD-03 Product Data

Hollow Metal Sound Retardant Doors; G

Wood Sound Retardant Doors; G

Door Frames; G

Door Hardware; G

Door Frame Sound Infill; G

Intumescent Seals and Gasketing; G

Thresholds; G

Astragals; G

SD-06 Test Reports

Wind Loading Tests; G

Water Leakage Tests; G

Acoustical Tests; G

Air Infiltration Tests; G

Positive Pressure Tests; G

SD-07 Certificates

Hollow Metal Sound Retardant Doors; G

Indoor Air Quality for Doors; S

Wood Sound Retardant Doors; G

Door Frames; G

Door Hardware; G

Intumescent Seals, Gasketing and Door Bottoms; G

Thresholds; G

Astragals; G

Assembly Test Reports

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.3.1.1 Composite Wood Doors

Provide wood composite doors certified to meet requirements of either California Air Resources Board (CARB) regulation Airborne Toxic Control

Measure (ATCM) to Reduce Formaldehyde Emissions from Composite Wood Products or California Department of Public Health (CDPH) Standard Method. Submit product data for indoor air quality for doors.

1.4 QUALITY CONTROL

Ensure work within this section is designed and furnished by one manufacturer, who has been engaged in the manufacture of Sound Retardant Wood Swinging Door and Hollow Metal Door systems for at least five years prior to the start of this work.

Provide acoustic assemblies manufactured by a single source specializing in the production of this type work for a minimum of five years.

1.4.1 Compliance and Labeling

1.4.1.1 Compliance with Accessibility Requirements

Americans with Disabilities Act/Architectural Barriers Act (ADA/ABA)
36 CFR 1191

Accessibility Guidelines for Buildings and Facilities (ADAAG) 36 CFR 1191

1.4.1.2 Category A Positive Pressure Fire Door Construction

Where requirements for positive pressure are met, include for doors all requirements as part of the door construction per Category A guidelines as published by ITS/Warnock-Hersey. Intumescent is not allowed on the frame. Applying smoke gasketing around the perimeter of the frame to meet the "S" smoke rating is permissible in instances where smoke control is required.

1.4.1.3 Category B Positive Pressure Fire Door Construction

Conform all door openings to the applicable portions of NFPA 101 and NFPA 252. Incorporate field applied intumescent materials, applied by a licensed installer according to the manufacturers' instructions. Keep instructions on file. Additional gasketing may be required to meet the 'S' smoke rating. Submit Certificate for intumescent seals, gasketing and door bottoms.

1.4.1.4 Labeling

Ensure all positive pressure door assemblies carry the fire label for the complete opening, clearly identifying the:

- a. Manufacturer
- b. Third party testing and certification agency
- c. Fire door rating
- d. Installation limitations
- e. Compatible frame, hardware component ratings
- f. 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.

1.5 DELIVERY, STORAGE, AND HANDLING

Ship all doors in the manufacturer's undamaged individual cartons, securely bundled and wrapped with moisture-resistant covers and stored in accordance with the manufacturer's printed instructions in a dry, clean, and ventilated area.

Deliver and store wood doors in the building following the installation of concrete, terrazzo, plaster, or other wet materials, and only after the building has dried out and has a roof.

Store all materials on planks in a dry location. Store doors and frames vertically with minimum 1/4" airspace between. Store doors on the edge to eliminate any potential damage to the door bottom seal. Cover all material to protect from damage but in a manner to allow proper circulation.

Maintain relative humidity in the building between 30 and 65 percent. Maintain the ambient temperature at 60 degrees F minimum at the time of installation of wood doors.

Perform final adjustment of seals when temperatures and humidity conditions replicate the interior conditions that will exist when the building is occupied.

1.6 WARRANTY

Manufacturer's warranty for 5 years from date of supply, covering material and workmanship. Failures include, but are not limited to, the following:

- a. Failure to meet sound rating requirements
- b. Faulty operation of sound seals
- c. Deterioration of metals, metal finishes, and other materials beyond normal use or weathering.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide sound retardant door assemblies of the thickness, width, and height indicated, complete with perimeter seals, seal housings, gasketing, automatic door bottoms, thresholds, door frames, and astragals as required to conform to the specified STC per ASTM E90 and ASTM E1289.

Submit fabrication drawings for Hollow Metal Sound Retardant Doors, Wood Sound Retardant Doors, Door Frames and Door Frame Sound Infill.

Submit certificates showing conformance with the referenced standards in this section, and manufacturer's catalog data including STC ratings and UL fire rating, where applicable, for the following items: Hollow metal sound retardant doors; wood sound retardant doors; door frames; door

hardware; 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).

2.1.1.1 Design Requirements

2.1.1.1.1 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.

2.1.1.1.2 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 1-1/2-hour B, 1 hour for stair tower doors, 3/4-hour C, 1-1/2-hour D 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.

Apply medium density overlay door facings over a good grade of hardwood conforming to NAAWS 3.1, Type 3 for job site-applied paint 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: Random match.
- d. Assembly of Veneer Leaves on Door Faces: Center-balance match.
- e. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
- f. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 20 feet or more.
- g. Room Match: Provide door faces of compatible color and grain within each separate room or area of building.
- h. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling.

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/A1008M or hot rolled, pickled and oiled steel conforming to ASTM A1011/A1011M. Comply steel shapes with ASTM A36/A36M and steel bars with ASTM A108, Grade 1018.

2.3.2 Door Frame Sound Infill

Grout: Comply with ASTM C476, with a slump of not more than 4 inches as measured according to ASTM C143/C143M.

Corrosion-Resistant Coating: Cold-applied asphalt mastic, compounded for 15 mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious

impurities.

Select the appropriate infill material.

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, astragals, 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 or surface mounted on face 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.

b. Color: As selected by Architect from full range of industry colors and color densities.

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 and UL 10C.

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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

08/18, CHG 1: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 ADMINISTRATIVE REQUIREMENTS
 - 1.2.1 Pre-Installation Meetings
- 1.3 SUBMITTALS
- 1.4 CERTIFICATIONS
 - 1.4.1 Indoor Air Quality Certifications
- 1.5 QUALITY CONTROL
 - 1.5.1 Qualifications
 - 1.5.1.1 Installer Qualifications
 - 1.5.1.2 Manufacturer Qualifications
 - 1.5.2 Single-Source Responsibility
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.6.1 Ordering
 - 1.6.2 Packing, Shipping, Handling and Unloading
 - 1.6.3 Storage and Protection
- 1.7 PROJECT / SITE CONDITIONS
 - 1.7.1 Field Measurements
- 1.8 WARRANTY

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Design Requirements for Aluminum (Entrances and Components)
 - 2.1.1.1 Material Standard
 - 2.1.1.2 Recycled Content
 - 2.1.1.3 Sealants
- 2.2 FABRICATION
 - 2.2.1 Entrance System Fabrication
 - 2.2.2 Shop Assembly
 - 2.2.2.1 Welding
 - 2.2.3 Finish
 - 2.2.4 Fabrication Tolerance
 - 2.2.4.1 Material Cuts
 - 2.2.4.2 Maximum Offset at Consecutive Members
 - 2.2.4.3 Joints
 - 2.2.4.4 Variation
 - 2.2.4.5 Flatness
- 2.3 MATERIALS
 - 2.3.1 Sealants
 - 2.3.2 Glass
- 2.4 ACCESSORIES
 - 2.4.1 Fasteners
 - 2.4.2 Perimeter Anchors
 - 2.4.2.1 Inserts and Anchorage Devices

- 2.4.3 Standard Entrance Hardware
 - 2.4.3.1 Threshold
 - 2.4.3.2 Panic Device
 - 2.4.3.3 Closer
 - 2.4.3.4 Security Lock or Dead Lock
 - 2.4.3.5 Cylinder(s)/Thumb-turn
 - 2.4.3.6 Cylinder Guard

PART 3 EXECUTION

- 3.1 EXAMINATION
 - 3.1.1 Site Verification of Conditions
- 3.2 PREPARATION
 - 3.2.1 Adjacent Surfaces Protection
 - 3.2.2 Aluminum Surface Protection
- 3.3 INSTALLATION
 - 3.3.1 Tolerances
 - 3.3.2 Adjusting
 - 3.3.3 Related Products Installation Requirements
 - 3.3.3.1 Sealants (Perimeter)
 - 3.3.3.2 Glass
- 3.4 FIELD QUALITY CONTROL
 - 3.4.1 Wind Loads
 - 3.4.2 Deflection
- 3.5 ADJUSTING AND CLEANING
 - 3.5.1 Protection
 - 3.5.2 Cleaning
- 3.6 WARRANTY

-- End of Section Table of Contents --

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

08/18, 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 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 E330/E330M	(2014) 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 F1642/F1642M	(2017) Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.4 (2013) Door Controls - Closers

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

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. 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 SystemsUL 2818 (2013) GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings

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. Deflection in accordance with ASTM F1642/F1642M
- c. Condensation Resistance and Thermal Transmittance Performance Requirements in accordance with AAMA 1503

- d. Water Infiltration in accordance with ASTM E331
- e. Structural Requirements in accordance with ASTM F1642/F1642M

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

Sample Warranty; G

List of Product Installations; G

SD-02 Shop Drawings

Installation Drawings; G

Fabrication Drawings; G

SD-03 Product Data

Manufacturer's Catalog Data; G

Finish; G

Recycled Content of Aluminum Material; S

SD-04 Samples

Finish and Color Samples; G

SD-06 Test Reports

Certified Test Reports; G

Deflection

Condensation Resistance and Thermal Transmittance

Water Infiltration

SD-07 Certificates

Indoor Air Quality For Sealants; S

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-11 Closeout Submittals

Manufacturer's Product Warranty

1.4 CERTIFICATIONS

1.4.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

Provide sealants applied within the building interior certified to meet indoor air quality requirements by California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for sealants.

1.5 QUALITY CONTROL

1.5.1 Qualifications

1.5.1.1 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.

1.5.1.2 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.

1.5.2 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 interior door portals as specified in this Section.
- 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.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Ordering

To avoid construction delays, comply with the manufacturer's lead-time requirements and instructions for ordering.

1.6.2 Packing, Shipping, Handling and Unloading

Deliver materials in the manufacturer's original, unopened, undamaged containers with identification labels intact.

1.6.3 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.

1.7 PROJECT / SITE CONDITIONS

1.7.1 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.

1.8 WARRANTY

Provide a written manufacturer's warranty, executed by a company official, warranting against defects in materials and products for 5 years from the date of substantial completion. 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 5 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 15 years from the shipment date and agreeing to promptly correct defects.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide aluminum entrances, with glass and glazing, door hardware, and components.

Aluminum entrances include interior aluminum-framed glass partition portals for wood doors as indicated.

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.

2.1.1.1 Material Standard

ASTM B221; 6063-T5 alloy and tempered.

Provide door as specified in Section 08 14 00 WOOD DOORS.

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.

2.2 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 sound rating.

c. Indicate typical glazing details, locations of various types and thickness of glass, 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

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 2-, 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 Joints

Between adjacent members in same assembly: Joints are hairline and square to the adjacent member.

2.2.4.4 Variation

In squaring diagonals for doors and fabricated assemblies: 1/16 inch.

2.2.4.5 Flatness

For doors and fabricated assemblies: plus/minus 1/16 inch of neutral plane.

2.3 MATERIALS

2.3.1 Sealants

Refer to Section 07 92 00 JOINT 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 Threshold

Provide an extruded aluminum threshold, one piece per door opening, with ribbed surface.

2.4.3.2 Panic Device

Provide the manufacturer's recommended standard panic hardware.

2.4.3.3 Closer

Provide a surface closer in accordance with ANSI/BHMA A156.4.

2.4.3.4 Security Lock or Dead Lock

Provide A/R MS 1850A lock with two A/R 1871 cylinder operated flush bolts.

2.4.3.5 Cylinder(s)/Thumb-turn

Provide the manufacturer's recommended standard.

2.4.3.6 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 Wind Loads

Provide a completed storefront system capable of withstanding wind pressure loads, normal to the wall plane indicated, as follows:

3.4.2 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.

3.5 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 --

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 44 00

CURTAIN WALL AND GLAZED ASSEMBLIES

05/19

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality Certifications
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Qualification of Welders
 - 1.4.2 Qualifications for the Curtain-Wall Installer
 - 1.4.3 Testing Requirements
 - 1.4.4 Factory Tests
 - 1.4.4.1 Deflection and Structural Tests
 - 1.4.4.2 Water Penetration Test
 - 1.4.4.3 Air Infiltration Test
 - 1.4.4.4 Delamination Test
 - 1.4.4.5 Sealant Adhesion and Compatibility Testing
 - 1.4.4.6 Energy Performance Tests
 - 1.4.4.7 Window Tests
 - 1.4.4.8 Fire Resistance Tests
 - 1.4.4.9 Noise Reduction
- 1.5 FIELD TESTS
 - 1.5.1 Field Water Spray Tests
 - 1.5.2 Air Infiltration
 - 1.5.2.1 Water Penetration
- 1.6 GLAZED CURTAIN WALL SYSTEM REQUIREMENTS
 - 1.6.1 Source
 - 1.6.2 Design
 - 1.6.3 Tolerances
 - 1.6.4 Structural Requirements
 - 1.6.5 Thermal Cycling and Vertical Inter-Story Movement Calculations
- 1.7 DELIVERY AND STORAGE
 - 1.7.1 Protective Covering
 - 1.7.2 Identification
- 1.8 WARRANTY
 - 1.8.1 Sample Warranties
- 1.9 INTERPRETATION OF AWS CODE
- 1.10 PERFORMANCE REQUIREMENTS
 - 1.10.1 Antiterrorism Performance Requirements
 - 1.10.2 Allowable Design Stresses
 - 1.10.3 Design Wind Load
 - 1.10.4 Structural Capacity

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Aluminum

- 2.1.1.1 Wrought Aluminum Alloys
- 2.1.1.2 Cast Aluminum Alloys
- 2.1.1.3 Welding Rods and Electrodes
- 2.1.1.4 Strength
- 2.1.2 Weathering High-Strength Low-Alloy Steel
- 2.1.3 High-Strength, Low-Alloy Steel
- 2.1.4 Metal Fasteners
- 2.1.5 Joint Sealants and Accessories
 - 2.1.5.1 Elastomeric, Single or Multiple Component
 - 2.1.5.2 Single Component Silicone Rubber Base
 - 2.1.5.3 Solvents and Primers
 - 2.1.5.4 Structural Sealant
 - 2.1.5.5 Backing Material
 - 2.1.5.6 Bond Preventive Materials
 - 2.1.5.7 Preformed Sealing Compound
- 2.1.6 Glass and Glazing
- 2.1.7 Firestopping Material
- 2.1.8 Screens
- 2.1.9 Paint and Finishes
- 2.1.10 Panels
 - 2.1.10.1 Laminated Panels
 - 2.1.10.1.1 Sub Title
 - 2.1.10.1.2 Sub Title
 - 2.1.10.1.3 Sub Title
 - 2.1.10.1.4 Interior Metal Facing
 - 2.1.10.2 Nonmetallic Panels
 - 2.1.10.3 Frames
 - 2.1.10.4 Window Construction
- 2.2 METALS FOR FABRICATION
 - 2.2.1 Aluminum-Alloy Extrusions
 - 2.2.2 Aluminum-Alloy Sheets and Plates
 - 2.2.3 Structural Steel
 - 2.2.4 Metals for Fasteners
- 2.3 NONSKINNING SEALING COMPOUND
- 2.4 FABRICATION
 - 2.4.1 Workmanship
 - 2.4.2 Shop-Painting Aluminum
 - 2.4.3 Shop-Painting Steel
 - 2.4.4 Depth of Glazing Rabbets
 - 2.4.5 Pigmented Organic Coating
- 2.5 CURTAIN-WALL FRAMING MEMBERS
 - 2.5.1 General
 - 2.5.2 Construction
- 2.6 ALUMINUM DOORS AND FRAMES
- 2.7 METAL ACCESSORIES
 - 2.7.1 Exterior Architectural Louvers
- 2.8 SUN CONTROL
 - 2.8.1 Sunshades
- 2.9 THERMAL INSULATION MATERIALS
- 2.10 SEALANTS AND CAULKINGS
- 2.11 CURTAIN-WALL INSTALLATION MATERIALS
 - 2.11.1 Threaded Concrete Inserts
 - 2.11.2 Wedge Concrete Inserts
 - 2.11.3 Slotted Concrete Inserts
 - 2.11.4 Masonry Anchorage Devices
 - 2.11.5 Toggle Bolts
 - 2.11.6 Steel Bolts, Nuts, and Washers
 - 2.11.7 Machine Screws
 - 2.11.8 Electrodes for Welding Steel

PART 3 EXECUTION

- 3.1 GENERAL
- 3.2 FABRICATION
 - 3.2.1 Joints
 - 3.2.2 Welding
 - 3.2.3 Soldering and Brazing
 - 3.2.4 Ventilation and Drainage
 - 3.2.5 Protection and Treatment of Metals
 - 3.2.5.1 General
 - 3.2.5.2 Galvanic Action
 - 3.2.5.3 Protection for Aluminum
- 3.3 INSTALLATION
 - 3.3.1 Bench Marks and Reference Points
 - 3.3.2 Verifying Conditions and Adjacent Surfaces
 - 3.3.3 Materials Embedded In Other Construction
 - 3.3.4 Fastening To Construction-In-Place
 - 3.3.5 Setting Masonry Anchorage Devices
 - 3.3.6 Field-Welding Steel And Touchup Painting
 - 3.3.7 Installation Tolerances
 - 3.3.8 Placing Curtain-Wall Framing Members
 - 3.3.9 Panel Installation
 - 3.3.10 Panels
 - 3.3.11 Windows
 - 3.3.11.1 Sealing
 - 3.3.11.2 Ventilators and Hardware
 - 3.3.11.3 Weatherstripping
 - 3.3.12 Joint Sealants
 - 3.3.12.1 Surface Preparation
 - 3.3.12.2 Applications
 - 3.3.12.3 Primer
 - 3.3.12.4 Backing
 - 3.3.12.5 Bond Prevention
 - 3.3.12.6 Protection and Cleaning
 - 3.3.13 Glass
 - 3.3.13.1 Inspection of Sash and Frames
 - 3.3.13.2 Preparation of Glass and Rabbets
 - 3.3.13.3 Positioning Glass
 - 3.3.13.4 Setting Methods
 - 3.3.13.5 Void Space
 - 3.3.13.6 Insulating Glass
 - 3.3.13.7 Insulating Glass With Edge Bands
 - 3.3.14 Firestopping
- 3.4 FINISHES
 - 3.4.1 Galvanizing
 - 3.4.1.1 Repair of Zinc-Coated Surfaces
 - 3.4.2 Shop Cleaning and Painting
 - 3.4.2.1 Cleaning
 - 3.4.2.2 Painting Steel or Iron Surfaces
 - 3.4.2.3 Painting Weathering Steel
- 3.5 FIELD TESTS
- 3.6 CLEANING AND PROTECTION
 - 3.6.1 General
 - 3.6.2 Manufacturer's Information
 - 3.6.3 Glass
 - 3.6.4 Aluminum Surfaces
 - 3.6.5 Other Metal Surfaces
- 3.7 INSPECTION AND ACCEPTANCE PROVISIONS

3.7.1 Finished Curtain-Wall System Requirements

3.7.2 Repair of Defective Work

-- End of Section Table of Contents --

SECTION 08 44 00

CURTAIN WALL AND GLAZED ASSEMBLIES

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.

ALUMINUM ASSOCIATION (AA)

AA ADM	(2020) Aluminum Design Manual
AA ASD1	(2017; Errata 2017) Aluminum Standards and Data

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 501.1	(2017) Standard Test Method for Water Penetration of Windows, Curtain Walls and Doors Using Dynamic Pressure
AAMA 501.2	(2015) Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls and Sloped Glazing Systems
AAMA 501.4	(2018) Recommended Static Test Method for Evaluating Window Wall, Curtain Wall and Storefront Systems Subjected to Seismic and Wind-Induced Inter-Story Drift
AAMA 501.5	(2007) Test Method for Thermal Cycling of Exterior Walls
AAMA 501.7	(2017) Recommended Static Test Method for Evaluating Windows, Window Wall, Curtain Wall and Storefront Systems Subjected to Vertical Inter-Story Movements
AAMA 609 & 610	(2015) Cleaning and Maintenance Guide for Architecturally Finished Aluminum
AAMA 800	(2016) Voluntary Specifications and Test Methods for Sealants
AAMA 2603	(2020) Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2605	(2020) Voluntary Specification, Performance Requirements and Test

	Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
AAMA CW-10	(2015) Care and Handling of Architectural Aluminum from Shop to Site
AAMA MCWM-1	(1989) Metal Curtain Wall Manual
AAMA/WDMA/CSA 101/I.S.2/A440	(2017) North American Fenestration Standard/Specification for Windows, Doors, and Skylights
AMERICAN HARDBOARD ASSOCIATION (AHA)	
AHA A135.4	(1995; R 2004) Basic Hardboard
AMERICAN IRON AND STEEL INSTITUTE (AISI)	
AISC/AISI 121	(2007) Standard Definitions for Use in the Design of Steel Structures
AISI SG03-3	(2002; Suppl 2001-2004; R 2008) Cold-Formed Steel Design Manual Set
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 WELDING SOCIETY (AWS)	
AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.10/A5.10M	(2021) Welding Consumables - Wire Electrodes, Wires and Rods for Welding of Aluminum and Aluminum-Alloys - Classification
AWS D1.1/D1.1M	(2020) 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 A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016a) Standard Specification for Zinc

	Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A242/A242M	(2013; R 2018) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A283/A283M	(2013) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A501/A501M	(2014) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A572/A572M	(2021) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588/A588M	(2019) Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
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 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	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B85/B85M	(2018) Standard Specification for Aluminum-Alloy Die Castings
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B136	(1984; R 2013) Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum
ASTM B137	(1995; R 2014) Standard Test Method for Measurement of Coating Mass Per Unit Area on Anodically Coated Aluminum
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B211/B211M	(2019) Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B244	(2009; R 2021) Standard Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM B308/B308M	(2010; R 2020) Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B316/B316M	(2020) Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold-Heading Wire and Rods
ASTM B429/B429M	(2010; E 2012) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C481	(1999; R 2011) Standard Test Method Laboratory Aging of Sandwich Constructions
ASTM C542	(2005; R 2017) Standard Specification for Lock-Strip Gaskets
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C665	(2017) Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C864	(2005; R 2015) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
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 C1135	(2015) Standard Test Method for

	Determining Tensile Adhesion Properties of Structural Sealants
ASTM C1184	(2014) Standard Specification for Structural Silicone Sealants
ASTM C1363	(2019) Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus
ASTM C1401	(2014) Standard Guide for Structural Sealant Glazing
ASTM D1037	(2012) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D1730	(2009; R 2020) Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
ASTM D2244	(2016) Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates
ASTM D3656/D3656M	(2013) Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM D4214	(2007; R 2015) Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
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 E136	(2019a) Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C
ASTM E283	(2019) Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E330/E330M	(2014) 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 E546	(2014; R 2020) Standard Test Method for Frost Point of Sealed Insulating Glass Units
ASTM E576	(2014; R 2020) Standard Test Method for Frost Point of Sealed Insulating Glass Units in the Vertical Position
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 E1332	(2016) Standard Classification for Rating Outdoor-Indoor Sound Attenuation
ASTM E3061	(2017) Standard Test Method for Analysis of Aluminum and Aluminum Alloys by Inductively Coupled Plasma Atomic Emission Spectrometry (Performance-Based Method)
ASTM F2248	(2012) Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2017) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2017) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence
NFRC 500	(2010) Procedure for Determining Fenestration Product Condensation Resistance Values

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 285	(2012) Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies
----------	--

Containing Combustible Components

PORCELAIN ENAMEL INSTITUTE (PEI)

PEI 1001 (1996) Specification for Architectural
Porcelain Enamel (ALS-100)

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4 (2007) Brush-Off Blast Cleaning

SSPC SP 1 (2015) Solvent Cleaning

SSPC SP 3 (2018) Power Tool Cleaning

SSPC SP 12/NACE No.5 (2002) Surface Preparation and Cleaning of
Metals by Waterjetting Prior to Recoating

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 4-010-01 (2018;with Change 1, 2020) DoD Minimum
Antiterrorism Standards for Buildings

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

Glazed Curtain Wall System; G

Installation Drawings

Shop-Painting Aluminum; G

Shop-Painting Steel; G

SD-03 Product Data

Glazed Curtain Wall System; G

Metals For Fabrication; G

Nonskinning Sealing Compound; G

Metal Accessories; G

Curtain-Wall Framing Members; G

Aluminum Doors and Frames; G

Thermal Insulation Materials; G

Masonry Anchorage Devices; G

Recycled Content of Aluminum Doors and Frames; S

Recycled Content of Aluminum Curtain-Wall Framing Members; S

Recycled Content of Aluminum Windows; S

Sample Warranties; G

SD-05 Design Data

Pigmented Organic Coating; G

Structural Calculations for Deflection; G

SD-06 Test Reports

NFPA 285 Factory Test Results; G

Field Water Spray Test Results; G

Air Infiltration Test Results; G

Water Penetration Test Results; G

SD-07 Certificates

Energy Performance Certificates; G

Qualifications for the Curtain-Wall Installer; G

Indoor Air Quality for Sealants; S

SD-08 Manufacturer's Instructions

Glazed Curtain Wall System; G

Insulating Glass; G

Preventive Maintenance and Inspection; G

SD-11 Closeout Submittals

Warranty; G

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

Provide sealants applied within the building interior certified to meet indoor air quality requirements by California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for sealants.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Welders

Welding must be performed by certified welders qualified in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

1.4.2 Qualifications for the Curtain-Wall Installer

Submit a written description of the proposed curtain-wall system installer giving the name of the curtain-wall manufacturer, qualifications of personnel, years of concurrent contracting experience, lists of projects similar in scope to the specified work. Installer must be approved by the Manufacturer as a Certified Installer and have a minimum of 5 years experience installing curtain wall systems, and have completed projects similar in size to this project.

1.4.3 Testing Requirements

The components listed below must be tested in accordance with the requirements below, and meet performance requirements specified.

- a. Joint and Glazing Sealants: Perform tests as required by applicable publications referenced.
- b. Preformed Compression Gaskets and Seals: ASTM C864.
- c. Preformed Lock-strip Gaskets: ASTM C542, modified as follows: Heat age specimens seven days at 158 degrees F, in zipped or locked position under full design compression. Unzip, cool for one hour, re-zip, and test lip seal pressure, which must be minimum 2.5 pounds per linear inch on any extruded or corner specimen.
- d. Spandrel Glass: Fallout resistance test, ASTM C1048.
- e. Porcelain Enamel: Acid resistance, color retention, and spall resistance tests, PEI 1001.
- f. Anodized Finishes: Stain resistance, coating weight, and coating thickness tests, ASTM B136, ASTM B137, and ASTM B244, respectively.
- g. Insulating Glass: ASTM E546 or ASTM E576 at minus 20 degrees F , no frost or dew point.

1.4.4 Factory Tests

Perform the following tests except that where a curtain wall system or component of similar type, size, and design as specified for this project has been previously tested, under the conditions specified herein, the resulting test reports may be submitted in lieu of testing the components listed below:

a. NFPA 285 Factory Test Results

1.4.4.1 Deflection and Structural Tests

Curtain wall framing members must not deflect, in a direction normal to the plane of the wall, more than $1/175$ of its clear span or $3/4$ inch, whichever is less, when tested in accordance with ASTM E330/E330M, except that when a plastered surface will be affected the deflection must not exceed $1/360$ of the span. Framing members must not have a permanent deformation in excess of 0.2 percent of its clear span when tested in accordance with ASTM E330/E330M for a minimum test period of 10 seconds at 1.5 times the design wind pressures specified. Provide Structural Calculations for Deflection.

1.4.4.2 Water Penetration Test

Water penetration must not occur when the wall is tested in accordance with ASTM E331 at a differential static test pressure of 20 percent of the inward acting design wind pressure as specified, but not less than 12 psf. Make provision in the wall construction for adequate drainage to the outside of water leakage or condensation that occurs within the outer face of the wall. Leave drainage and weep openings in members and wall open during test.

1.4.4.3 Air Infiltration Test

Air infiltration through the wall, when tested in accordance with ASTM E283, must not exceed 0.06 cfm per square foot of fixed wall area, plus the permissible allowance specified for operable windows within the test area, at a static air pressure differential of 6.2 psf.

1.4.4.4 Delamination Test

Adhesively bonded metal-faced panels must show no evidence of delamination, warpage or other deterioration or damage when subjected to the six "Accelerated Aging Cycles" specified in ASTM D1037.

1.4.4.5 Sealant Adhesion and Compatibility Testing

ASTM C1401, submit to structural glazing sealant manufacturer, for testing indicated below. Samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.

- a. Compatibility: Test materials or components using ASTM C1087.
- b. Adhesion: Test for adhesion or lack of adhesion of a structural sealant to the surface of another material or component using ASTM C1135.

- c. Submit no fewer than 8 pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
- d. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
- e. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures, including the use of specially formulated primers.
- f. Testing will not be required if data based on previous testing of current sealant products match those submitted.

1.4.4.6 Energy Performance Tests

Energy Performance Certificates for Glazed Aluminum Curtain Wall, Accessories, and Components from Manufacturer Confirming NFRC- Certified Energy Performance Values for Each Glazed Aluminum Curtain Wall.

The thermal transmittance of opaque panels must not exceed specified U-value, when tested in accordance with ASTM C1363. Certify and Label Energy Performance according to NFRC as follows:

- a. Thermal Transmittance (U-factor): Fixed glazing and framing areas as a system must have U-factor of not more than 0.42 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
- b. SHGC: Fixed glazing and framing areas as a system must have a SHGC of no greater than 0.40 as determined according to NFRC 200.
- c. Condensation Resistance: Fixed glazing and framing areas as a system must have an NFRC-certified condensation resistance rating of no less than 66 for frames and 60 for glass as determined according to NFRC 500.

1.4.4.7 Window Tests

Windows must meet the requirements in this section. Provide windows that meet the same requirements for deflection and structural adequacy as specified for framing members when tested in accordance with ASTM E330/E330M, except permanent deformation must not exceed 0.4 percent; there must be no glass breakage, and no permanent damage to fasteners, anchors, hardware, or operating devices. Provide windows that have no water penetration when tested in accordance with ASTM E331.

1.4.4.8 Fire Resistance Tests

Insulation provided in the curtain wall system or field applied in conjunction with the curtain wall system must have a flame spread rating not exceeding 75 and a smoke developed rating not exceeding 150 when tested in accordance with ASTM E84, except as specified otherwise herein.

- a. Insulation: Insulation contained entirely within panel assemblies which meets the flame spread and smoke developed ratings of 75 and 150 respectively is not required to comply with the flame spread and smoke developed ratings specified.
- b. Curtain Wall Systems: Material for firestopping the opening between the edge of the floor slab and back of the curtain wall system, must

not have less than the flame spread and smoke developed ratings specified for insulation which is neither isolated from the building interior nor encased in masonry cores. When required, entire curtain wall system must conform to NFPA 285.

- c. Firestopping Materials and Devices: Firestopping material and attachment devices must be an effective barrier against the spread of fire, smoke, and gases for a period of 2 hours when exposed to the conditions of the standard ASTM E119 time-temperature curve for a period equivalent to the fire rating of the floor system and must also be rated noncombustible when tested in accordance with ASTM E136.

1.4.4.9 Noise Reduction

Test according to ASTM E90, with ratings determined by ASTM E1332, as follows: Outdoor-Indoor Transmission Class: Minimum 30. Sound Transmission Class: Minimum 37.

1.5 FIELD TESTS

Testing must be performed by a testing agency regularly engaged in testing of architectural products, not affiliated with the curtain wall installer, and experienced with these test methods. Notify the Contracting Officer a minimum of seven calendar days prior to performing field tests.

1.5.1 Field Water Spray Tests

Engage a qualified testing agency to perform tests and inspection. Perform test on one bay of at least 30 feet long by one story. Perform water-spray test before interior finishes have begun, in accordance with AAMA 501.2. Test area must not show evidence of water penetration. Perform a minimum of 3 tests. Submit Field Water Spray Test Results.

1.5.2 Air Infiltration

ASTM E783 at 1.5 times the rate specified for laboratory testing under factory test paragraph, but not more than 0.06 cfm/sq.ft at a static air pressure differential of 6.24 lbf/sq.ft. Perform a minimum of 3 tests in representative areas. Submit Air Infiltration Test Results.

1.5.2.1 Water Penetration

ASTM E1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft., and must not evidence water penetration. Submit Water Penetration Test Results.

1.6 GLAZED CURTAIN WALL SYSTEM REQUIREMENTS

Provide system complete with framing, mullions, trim, framed pre-assembled units, panels, windows, glass, glazing, sealants, insulation, fasteners, anchors, accessories, concealed auxiliary members, and attachment devices for securing the wall to the structure as specified or indicated.

Submit installation drawings for curtain wall system, accessories. Drawings must indicate in detail all system parts including elevations, full-size sections, framing, jointing, panels, types and thickness of metal, flashing and coping details, field connections, weep and drainage

system, finishes, sealing methods, glazing, glass sizes and details, firestopping insulation materials, and erection details.

1.6.1 Source

Furnish curtain wall system components by one manufacturer or fabricator; however, all components need not be products of the same manufacturer.

1.6.2 Design

Stick system with mullions, horizontal rails, and panels. Fully coordinate system accessories directly incorporated, and adjacent to contiguous related work and insure materials compatibility, deflection limitations, thermal movements, and clearances and tolerances as indicated or specified.

1.6.3 Tolerances

Design and erect wall system to accommodate tolerances in building frame and other contiguous work as indicated or specified. Provide with the following tolerances:

- a. Maximum variation from plane or location shown on approved shop drawings: 1/8 inch per 12 feet of length up to not more than 1/2 inch in any total length.
- b. Maximum offset from true alignment between two identical members abutting end to end in line: 1/16 inch.

1.6.4 Structural Requirements

Members may not deflect in a direction parallel to the plane of the wall, when carrying its full design load, more than an amount which will reduce the edge cover or glass bite below 75 percent of the design dimension. After deflection under full design load, members may not have a clearance between itself and the top of the panel, glass, sash, or other part immediately below it less than 1/8 inch. The clearance between the member and an operable window or door must be minimum 1/16 inch. Design entire system to withstand the indicated wind and concentrated loads indicated in this specification and on the structural drawings.

1.6.5 Thermal Cycling and Vertical Inter-Story Movement Calculations

- a. Thermal Cycling: AAMA 501.5. Repeat the Air Infiltration Test, ASTM E283, and the Water Penetration Test Under Static Pressure, ASTM E331.
- b. Inter-Story Drift: AAMA 501.4 and AAMA 501.7 at 100 percent of design displacement. Repeat the Air Infiltration Test, ASTM E283 and the Water Penetrated Test Under Static Pressure, ASTM E331.

1.7 DELIVERY AND STORAGE

Inspect materials delivered to the site for damage; unload and store with a minimum of handling in accordance with recommendations contained in AAMA CW-10. Storage spaces must be dry locations with adequate ventilation, free from heavy dust, not subject to combustion products or sources of water, and must allow for easy access for inspection and handling. Deliver caulking and sealing compounds to the job site in sealed

containers labeled to show the designated name, formula or specifications number; lot number; color; date of manufacturer; shelf life; and curing time when applicable.

1.7.1 Protective Covering

Prior to shipment from the factory, place knocked-down lineal members in cardboard containers and cover finished surfaces of aluminum with protective covering of adhesive paper, waterproof tape, or strippable plastic. Covering must not chip, peel, or flake due to temperature or weather, must protect against discoloration and surface damage from transportation, and storage, and must be resistant to alkaline mortar and plaster. Do not cover aluminum surfaces that will be in contact with sealants after installation.

1.7.2 Identification

Prior to delivery, mark wall components to correspond with shop and erection drawings placement location and erection.

1.8 WARRANTY

Guarantee insulating glass units not to develop material obstruction of vision as a result of dust or film formation on the inner glass surface caused by failure of the seal, other than through glass breakage, within a period of 5 years from date of acceptance of work by the Government. Replace units failing to comply with the terms of this guarantee with new units without additional cost to the Government. The Contractor must require the manufacturer to execute their warranties in writing directly to the Government.

1.8.1 Sample Warranties

Provide curtain wall and glazing assembly material and workmanship warranties meeting specified requirements. Provide revision or amendment to standard membrane manufacturer warranty to comply with the specified requirements.

- a. Project Warranty: Refer to Section 01 78 36.00 24 WARRANTY OF CONSTRUCTION.
- b. Manufacturer's Warranty: Submit, for acceptance, the Manufacturer's standard warranty document executed by authorized company official. The manufacturer's warranty is in addition to, and not a limitation of, other rights the Government may have under the Contract Documents.
- c. Assembly Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of steel fire-rated glazed curtain-wall systems that do not comply with requirements or that deteriorate as defined in this Section within specified warranty period.
- d. Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes fail within specified warranty period. Warranty does not include normal weathering. Deterioration includes, but is not limited to, color fading more than 5 Delta E units when tested according to ASTM D2244, chalking in excess of a No. 8 rating when tested according to ASTM D4214, cracking, peeling, or chipping.

- e. Beneficiary: Issue warranty to the Government.
- f. Warranty Period: 10 years commencing on Date of Substantial Completion, covering complete curtain wall system for failure to meet specified requirements.
- g. Warranty Acceptance: Owner is sole authority who will determine acceptability of manufacturer's warranty documents.

1.9 INTERPRETATION OF AWS CODE

AWS code, when referred to herein, means AWS D1.1/D1.1M, "Structural Welding Code - Steel" with the following modification:

Revise AWS code Section 1, "General Provisions," Paragraph 1.1 as follows: References to the need for approval means "Approval by the Contracting Officer" and references to the "Building Commissioner" means the "Contracting Officer."

1.10 PERFORMANCE REQUIREMENTS

1.10.1 Antiterrorism Performance Requirements

Curtain Wall must meet the minimum DOD standard 3-11.1 Glazing in UFC 4-010-01. For glazing in exterior building elements such as storefronts, doors, windows, curtain walls, clerestories provide a glazing frame bite in accordance with ASTM F2248.

1.10.2 Allowable Design Stresses

Aluminum-alloy framing member allowable design stresses must be in accordance with the requirements of AA ADM pertaining to building type structures made of the specified aluminum alloy.

Hot-rolled structural-steel member allowable design stresses and design rules must be in accordance with the requirements of AISC/AISI 121 pertaining to the specified structural steel.

Cold-formed light-gage steel structural member allowable design stresses and design rules must be in accordance with the requirements of AISI SG03-3 SG570 pertaining to structural members formed from the specified structural-steel sheet or strip.

1.10.3 Design Wind Load

Design windload must be as indicated on the drawings. Design windload must be in accordance with ASCE 7-16.

1.10.4 Structural Capacity

Design curtain-wall system, including framing members, windows, doors and frames, metal accessories, panels, and glazing to withstand the specified design windload acting normal to the plane of the curtain wall and acting either inward or outward.

Deflection of any metal framing member in a direction normal to the plane of the curtain wall, when subjected to the test of structural performance, using the specified windload in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, must not exceed 1/175 of the clear span of

the member or 3/4 inch, whichever value is less.

Deflection of any metal member in a direction parallel to the plane of the curtain wall, when the metal member is carrying its full design load, must not exceed 75 percent of the design clearance dimension between that member and the glass, sash, panels, or other part immediately below it.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum

Must be free from defects impairing strength or durability of surface finish. Provide standard alloys conforming to standards and designations of AA ASD1. Special alloys, not covered by the following ASTM specifications, must conform to standards and designations recommended by the manufacturer for the purpose intended.

Provide Aluminum Doors, Frames, Curtain-wall Framing Members, and Window Frames with a minimum recycled content of 20 percent. Provide data identifying percentage of recycled content of aluminum doors and frames, recycled content of aluminum curtain-wall framing members, and recycled content of aluminum windows.

2.1.1.1 Wrought Aluminum Alloys

Must be those which include aluminum alloying elements not exceeding the following maximum limits when tested and additional in accordance with ASTM E3061. These limits apply to both bare products and the core of clad products. The cladding of clad products must be within the same limits except that the maximum zinc limit may be 2.5 percent in order to assure that the cladding is anodic to the core. Special wrought alloys with a silicon content not more than 7.0 percent will be acceptable for limited structural uses where special appearance is required:

<u>ALLOY</u>	<u>MAXIMUM PERCENT</u>
Silicon	1.5
Magnesium, Manganese, and Chromium combined	6.0
Iron	1.0
Copper	0.4
Zinc	1.0

Within the chemical composition limits set forth above, wrought aluminum alloys must conform to the following:

- a. Extruded bars, rods, shapes and tubes: ASTM B221 and ASTM B308/B308M and ASTM B429/B429M.
- b. Sheet and Plate: ASTM B209.

2.1.1.2 Cast Aluminum Alloys

Provide those in which the alloying elements are silicon, magnesium, manganese, or a combination of these. Other elements must not exceed the following limits:

<u>ALLOY</u>	<u>MAXIMUM PERCENT</u>
Iron	1.2
Copper	0.4
Nickel	0.4
Titanium	0.2
Others (total)	0.5

Within the chemical composition limits set forth above, cast aluminum alloys must conform to the following:

- a. Sand castings: ASTM B26/B26M.
- b. Die casting: ASTM B85/B85M.
- c. Permanent mold castings: ASTM B108/B108M.

2.1.1.3 Welding Rods and Electrodes

Provide welding rods and bare electrodes conforming to AWS A5.10/A5.10M as recommended by the manufacturer of the aluminum base metal alloy being used.

2.1.1.4 Strength

Aluminum extrusions for framing members used in curtain walls and main frame and sash or ventilator members in windows must have a minimum ultimate tensile strength of 22,000 psi and a minimum yield strength of 16,000 psi.

2.1.2 Weathering High-Strength Low-Alloy Steel

Weathering steel must be a high-strength, low-alloy steel conforming to ASTM A242/A242M, ASTM A588/A588M, ASTM A606/A606M, and ASTM A1011/A1011M as applicable to the shapes and thicknesses required. In addition, the steel must be capable of developing a tightly adhered protective oxide coating when left unpainted and subjected to atmospheric exposure. Provide steel that conforms to the manufacturer's published mechanical properties and chemical composition. Perform cleaning, surface preparation, handling, bolting, riveting, and welding of weathering steel in strict accordance with the specification and recommendations of the steel manufacturer.

2.1.3 High-Strength, Low-Alloy Steel

Conform to ASTM A572/A572M for structural shapes, plates, and bars.

2.1.4 Metal Fasteners

Provide fasteners as specified in paragraph entitled "Fastener Metals for Joining Various Metal Combinations" in "Part 2 - Products" of the AAMA MCWM-1. Fastener metals used in connection with weathering steel must be of type recommended by the weathering steel manufacturer. Metals for fasteners must be chemically and galvanically compatible with contiguous materials.

2.1.5 Joint Sealants and Accessories

Provide manufacturer's standard colors to closely match adjacent surfaces. For interior application of joint sealants comply with applicable regulations regarding reduced VOC's as specified in Sections 07 92 00 JOINT SEALANTS and 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

2.1.5.1 Elastomeric, Single or Multiple Component

ASTM C920, Type M, multiple component. Use Grade NS, nonsag type in joints on vertical surfaces and use Grade P, self-leveling or flow type, in joints on horizontal surfaces.

2.1.5.2 Single Component Silicone Rubber Base

ASTM C920, Type S, Grade NS (Silicone).

2.1.5.3 Solvents and Primers

Provide material which is quick drying, colorless, nonstaining, compatible with compound used, as recommended by sealant manufacturer. Where primer is specified or recommended by sealant manufacturer, manufacturer's data related to that material must include primer.

2.1.5.4 Structural Sealant

ASTM C1184 and ASTM C1401. Capable of withstanding tensile and shear stresses imposed by structural-sealant-glazed curtain walls without failing adhesively or cohesively. When tested for preconstruction adhesion and compatibility, cohesive failure of sealant must occur before adhesive failure. Adhesive failure occurs when sealant pulls away from substrate cleanly, leaving no sealant material behind. Cohesive failure occurs when sealant breaks or tears within itself but does not separate from each substrate, because sealant-to-substrate bond strength exceeds sealant's internal strength.

2.1.5.5 Backing Material

Provide material which is nonstaining, nonabsorbent, and compatible with sealing compound. Closed cell resilient urethane, polyvinylchloride or polyethylene foam; closed-cell sponge of vinyl or rubber; closed cell neoprene or butyl rod; or polychloroprene tubes or beads.

2.1.5.6 Bond Preventive Materials

Provide polyethylene tape with pressure-sensitive adhesive; aluminum foil or waxed paper.

2.1.5.7 Preformed Sealing Compound

Provide nonskinning type conforming to AAMA 800. Tapes, beads, ribbons or other shapes as required.

2.1.6 Glass and Glazing

Materials are specified under Section 08 81 00 GLAZING.

2.1.7 Firestopping Material

Mineral fiber manufactured from asbestos-free materials, and conforming to ASTM C612 or ASTM C665, meeting fire resistance requirements specified.

2.1.8 Screens

ASTM D3656/D3656M, Class 2, 18 by 14 mesh, color charcoal.

2.1.9 Paint and Finishes

See Section 09 90 00 PAINTS AND COATINGS, for field applied coatings.

2.1.10 Panels

Maximum U-value 0.42. Where, in order to meet the requirements specified, the proposed panel assembly is thicker than indicated, make corresponding adjustments in accessories and other work such as door, window and louver frames, flashing, coping, and trim products at no extra cost to the Government. Unless otherwise indicated, design for installation from outside the building. Provide vapor barrier on interior face of insulation. Seal edges of panels with cores of absorptive material to prevent entrance of water and allow venting of the core space to outside air. Panels must comply with ASTM E84 surface burning characteristics, with a flame spread index of 25 or less and a smoke developed index of 450 or less tested by a Qualified Testing Agency. Identify products with appropriate markings of Applicable Testing Agency. Tempered Hardboard must conform to AHA A135.4, Class 1, 1 inch thick.

2.1.10.1 Laminated Panels

Panels must be metal-faced laminated both sides, consisting of exterior metal facing, facing backing, insulating core, facing backing, and interior metal facing. Facing-panel dimensions must be as indicated. 2.1.15.2.1 Exterior Metal Facing Facing must be Porcelain-Enamel on steel. Base metal must be steel sheets for porcelain enameling, 0.010 to 0.015 inch thick, of the quality and type best suited for the work, stretcher level standard of flatness, conforming to ASTM A424/A424M, and properly precleaned and treated for adherence of the porcelain enamel. Porcelain-enamel processing, corrosion protection, weather resistance, color retention of red, yellow, and orange porcelain enamels, continuity of coating, and surface appearance must meet or exceed the requirements specified in PEI 1001. Color of porcelain-enamel exposed-to-view surfaces must match the adjacent mullion color.

2.1.15.2.2 Facing Backing Nominal 1/8-inch thick, flat non-asbestos-cement sheets, flexible smooth-one-side surface finish, conforming to ASTM C220, Type F. 2.1.15.2.3 Core Insulation Core must be preformed block polystyrene conforming to ASTM C578, Type II.

2.1.10.1.1 Sub Title

Text

2.1.10.1.2 Sub Title

Text

2.1.10.1.3 Sub Title

Text

2.1.10.1.4 Interior Metal Facing

Facing must be as specified for exterior metal facing.

Panel Fabrication

Securely bond panel materials together to form a stable and durable composite unit. Panels with core insulation of absorptive material must have edges sealed and provide venting to the outside air. Provide panels that conform to the following:

Flatness: Provide exterior surfaces of such flatness that, when measured at room temperature, the maximum slope of the surface at any point, measured from the nominal plane of the surface, that do not exceed the following:

1.0 percent for surfaces having a finish of high reflectivity

1.25 percent for surfaces having a finish of medium reflectivity

1.5 percent for surfaces having a finish of low reflectivity

Structural requirements: Panels of the maximum size required by the work, when supported in the manner intended, must withstand the windload specified without permanent deformation or damage.

Accelerated aging: Panels must show no evidence of delamination, warpage, or other deterioration or damage after completion of six accelerated aging cycles in accordance with ASTM C481, Cycle A.

Thermal transmittance: U-factor of a panel, when a panel not less than 10 square feet in area and of identical construction is tested in accordance with ASTM C1363, must be as follows:

Not more than 0.42 Btu/hr-square foot-degree F.

2.1.10.2 Nonmetallic Panels

- a. Provide insulated glass panels that are glass-faced on the side that will be exposed to view as indicated. Glass must be spandrel glass with ceramic coating on its nonweathering surface and smooth finish on the exposed surface.

2.1.10.3 Frames

Frames for fixed glazed panels and window units must be aluminum.

2.1.10.4 Window Construction

Weld or mechanically join and seal corners of frames and ventilators for water-tight construction. Remove excess metal from welded joints and dress smooth on exposed and contact surfaces so that no objectionable discoloration or roughness will be visible after finishing. Apply sealing compound in interior surfaces of corners and frame intersections.

2.2 METALS FOR FABRICATION

2.2.1 Aluminum-Alloy Extrusions

Extrusions must conform to ASTM B221.

Extrusions to receive an integral-color anodic coating must be the alloy and temper recommended by the aluminum producer for the specified finish with integral-color anodic coating and have mechanical properties equal to or exceeding those of ASTM B221 6063-T5.

2.2.2 Aluminum-Alloy Sheets and Plates

Unless otherwise specified, sheets and plates must conform to ASTM B209, Alloy 3003-H16.

Sheets and plates to receive a clear anodic coating must conform to ASTM B209, Alloy 5005-H16.

Sheets and plates to receive an integral-color anodic coating must be the alloy and temper recommended by the aluminum producer for the specified coating and have mechanical properties equal to or exceeding those of 5005-H16.

2.2.3 Structural Steel

Hot-rolled shapes, plates, and bars must conform to ASTM A36/A36M.

Hot-formed tubing must conform to ASTM A501/A501M.

Sheet and strip for cold-formed, light-gage, structural members must conform to ASTM A1011/A1011M.

2.2.4 Metals for Fasteners

Provide aluminum-alloy bolts and screws made from rod conforming to ASTM B211/B211M, Alloy 2024-T351.

Provide aluminum-alloy nuts made from rod conforming to ASTM B211/B211M, Alloy 6061-T6.

Provide aluminum-alloy washers made from sheet conforming to ASTM B209, ASTM B211/B211M, Alloy 2024-T4.

Provide aluminum-alloy rivets made from rod or wire conforming to ASTM B316/B316M, Alloy 6053-T61.

Provide steel fasteners made from corrosion-resistant chromium-nickel Type 302, 303, 304, 305, or 316 with the form and condition best suited for the work.

2.3 NONSKINNING SEALING COMPOUND

Sealing compound must be nonskinning, gun-grade type conforming to AAMA 800.

2.4 FABRICATION

2.4.1 Workmanship

Metal Accessories must be accurately formed; joints, except those designed to accommodate movement, accurately fitted and rigidly assembled.

Insofar as practical, fitting and assembly of the work must be done in the manufacturer's plant. Mark work that cannot be permanently factory-assembled before shipment to ensure proper assembly at the site.

2.4.2 Shop-Painting Aluminum

Shop prime aluminum surfaces that will come in contact with dissimilar metals, masonry, concrete, or wood.

Prepare aluminum surfaces for painting in accordance with ASTM D1730, Type B, Method 2 or 3.

Give aluminum surfaces one shop coat of paint applied to dry, clean, surfaces to provide a continuous minimum dry-film thickness of 1.5 mils.

2.4.3 Shop-Painting Steel

Shop prime surfaces of concealed steel.

Remove scale, rust, and other deleterious materials. Remove heavy rust and loose mill scale in accordance with SSPC SP 3 or SSPC 7/NACE No.4. Remove oil, grease, and similar contaminants in accordance with SSPC SP 1.

Give steel surfaces two coats of paint; the second coat must have a color different from the first coat. Apply paint to dry, clean, surfaces to provide a continuous minimum dry-film thickness of 1.5 mils for the first coat and 1 mil for the second coat.

2.4.4 Depth of Glazing Rabbets

Depth of glazing rabbets for openings to receive glass materials or panels must be as follows:

<u>MATERIAL</u>	<u>NOMINAL THICKNESS</u>	<u>MAXIMUM SIZE</u>	<u>MINIMUM RABBET DEPTH</u>
Double-glazing units	All thicknesses	Up to 25 square feet	5/8 inch
	All thicknesses	25 to 70 square feet	3/4 inch

2.4.5 Pigmented Organic Coating

Curtain wall framing exposed to view to be a pigmented organic coating complying with AAMA 2603 a superior performing organic coating complying with AAMA 2605 Color: As indicated.

2.5 CURTAIN-WALL FRAMING MEMBERS

2.5.1 General

Framing members must be thermally broken and be the section dimensions and arrangement indicated and designed to accommodate windows, panels, and other materials to be incorporated into the curtain-wall system.

Curtain-wall framing must be the grid type with both the vertical and horizontal mullions extending the indicated distance beyond the exterior face of the curtain wall.

2.5.2 Construction

Framing members must be aluminum-alloy extrusions with a wall thickness not less than 0.125 inch. Glazing rabbet legs must be an integral part of the frame with the leg depth not less than the minimum depth specified for the thickness and size of the glass material or panel to be installed in the curtain-wall frame. Design and construct frames to receive window sash and louvers of the type specified when required.

Prepare vertical mullions for anchorage to the building construction at the bottom, at each intermediate floor elevation, and at the top.

Corners of frames must be mortise-and-tenon construction except that the corners of the vertical and horizontal mullions in grid frames must be coped-and-welded construction. Welds must be on the unexposed surfaces. Corner joints must be accurately fitted and flush, with watertight hairline joints not exceeding 1/64 inch in width. Apply nonskinning sealing compound to the unexposed surfaces of all mortise-and-tenon joints.

2.6 ALUMINUM DOORS AND FRAMES

Aluminum doors and frames are specified in Section 08 11 16 ALUMINUM DOORS AND FRAMES.

2.7 METAL ACCESSORIES

2.7.1 Exterior Architectural Louvers

Exterior architectural louvers are specified in Section 08 11 13 STEEL DOORS AND FRAMES.

2.8 SUN CONTROL

Provide sunshades in accordance with the following:

2.8.1 Sunshades

Assemblies consisting of manufacturer's standard outrigger brackets, louvers, and fascia, designed for attachment to curtain wall with mechanical fasteners.

- a. Orientation: Horizontal.
- b. Projection from Wall: As indicated on Drawings.
- c. Outriggers: Straight with square edges.

d. Louvers:

- (1) Number: Five louvers per unit.
- (2) Shape: Airfoil .
- (3) Width: 8 inches.
- (4) Mounting Angle: 35 degrees.

e. Fasciae: Rectangular .

f. Finish: Match adjacent glazed aluminum curtain wall.

g. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

h. Steel Reinforcement: As required by manufacturer.

2.9 THERMAL INSULATION MATERIALS

Thermal insulation materials are specified in Section 07 21 16 MINERAL FIBER BLANKET INSULATION and Section 07 21 13 BOARD AND BLOCK INSULATION.

2.10 SEALANTS AND CAULKINGS

Sealants and caulking are specified in Section 07 92 00 JOINT SEALANTS.

2.11 CURTAIN-WALL INSTALLATION MATERIALS

2.11.1 Threaded Concrete Inserts

Galvanized ferrous castings with enlarged bases with not less than two nailing lugs, length as indicated, internally threaded 3/4-inch diameter machine bolt must conform to ASTM A47/A47M, Grade 35018 or ASTM A27/A27M, Grade U-60-30, and hot-dip galvanized in accordance with ASTM A153/A153M.

2.11.2 Wedge Concrete Inserts

Galvanized, box-type, ferrous castings with an integral loop at the back of the box and designed for 3/4-inch diameter bolts with wedge-shaped heads must conform to ASTM A47/A47M, Grade 35018 or ASTM A27/A27M, Grade U-60-30, and hot-dip galvanized in accordance with ASTM A153/A153M.

Carbon steel bolts with wedge-shaped heads, nuts, washers, and shims must be hot-dip galvanized in accordance with ASTM A153/A153M.

2.11.3 Slotted Concrete Inserts

Galvanized pressed-steel plate, welded construction, box type with a slot designed for 3/4-inch diameter square-head bolts to provide lateral adjustment must be 1/8-inch minimum thickness, conforming to ASTM A283/A283M, Grade C, hot-dip galvanized in accordance with ASTM A123/A123M. Length of the insert body less anchorage lugs must be 6 inches minimum and provided with a knockout cover.

2.11.4 Masonry Anchorage Devices

2.11.5 Toggle Bolts

Toggle bolts must be the tumble-wing type.

2.11.6 Steel Bolts, Nuts, and Washers

Bolts must be regular hexagon head, low-carbon steel.

Nuts must be hexagon, regular style, carbon steel.

Plain washers must be round, general-assembly purpose, carbon steel.

Lockwashers must be helical spring, carbon steel.

2.11.7 Machine Screws

Provide screws for concealed work that are corrosion-resistant steel, slotted or cross-recessed type, roundhead.

Provide screws for exposed-to-view work that are corrosion-resistant steel, cross-recessed, flathead.

2.11.8 Electrodes for Welding Steel

Electrodes for welding steel by the manual shielded metal arc welding process must meet the requirements of AWS D1.1/D1.1M and be covered mild-steel electrodes conforming to AWS A5.1/A5.1M, E60 series.

PART 3 EXECUTION

3.1 GENERAL

Install curtain walls and accessories in accordance with the approved drawings and as specified.

3.2 FABRICATION

Provide curtain wall components of the materials and thickness indicated or specified. The details indicated are representative of the required design and profiles. Acceptable designs may differ from that shown if the proposed system components conform to the limiting dimensions indicated and the requirements specified herein. Unless specifically indicated or specified otherwise, the methods of fabrication and assembly must be at the discretion of the curtain wall manufacturer. Perform fitting and assembling of components in the shop to the maximum extent practicable. Provide anchorage devices with adjustment capability in three directions. Exposed fastenings used on finished surfaces must be truss head, flat head, or oval head screws or bolts.

3.2.1 Joints

Provide welded or mechanical fasteners as indicated or specified. Match joints in exposed work to produce continuity of line and design. Bed-joints or rabbets receiving caulking or sealing material must be minimum 3/4 inch deep and 3/8 inch wide at mid ambient temperature range.

3.2.2 Welding

Conform to AWS D1.1/D1.1M. Use methods and electrodes recommended by manufacturers of base metal alloys. Provide welding rods of an alloy that matches the color of the metal being welded. Protect glass and other finish from exposure to welding spatter. Ground and finish weld beads on exposed metal surfaces to minimize mismatch and to blend with finish on adjacent parent metal. If flux is used in welding aluminum, completely remove it immediately upon completion of welding operations. Do not use exposed welds on aluminum surfaces.

3.2.3 Soldering and Brazing

Provide as recommended by suppliers. Solder only for filling or sealing joints.

3.2.4 Ventilation and Drainage

Provide internal ventilation and drainage system of weeps based on principles of pressure equalization to ventilate the wall internally and to discharge condensation and water leakage to exterior as inconspicuously as possible. Flashings and other materials used internally must be nonstaining, noncorrosive, and nonbleeding.

3.2.5 Protection and Treatment of Metals

3.2.5.1 General

Remove from metal surfaces lubricants used in fabrication and clean off other extraneous material before leaving the shop.

3.2.5.2 Galvanic Action

Provide protection against galvanic action wherever dissimilar metals are in contact, except in the case of aluminum in permanent contact with galvanized steel, zinc, stainless steel, or relatively small areas of white bronze. Paint contact surfaces with one coat bituminous paint or apply appropriate caulking material or nonabsorptive, noncorrosive, and nonstaining tape or gasket between contact surfaces.

3.2.5.3 Protection for Aluminum

Protect aluminum which is placed in contact with, built into, or which will receive drainage from masonry, lime mortar, concrete, or plaster with one coat of alkali-resistant bituminous paint. Where aluminum is contacted by absorptive materials subject to repeated wetting or treated with preservative noncompatible with aluminum, apply two coats of aluminum paint, to such materials and seal joints with approved caulking compound.

3.3 INSTALLATION

Installation and erection of glazed wall system and all components must be performed under direct supervision of and in accordance with approved recommendations and instructions of wall system manufacturer or fabricator.

Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

3.3.1 Bench Marks and Reference Points

Establish and permanently mark bench marks for elevations and building line offsets for alignment at convenient points on each floor level. Should any error or discrepancy be discovered in location of the marks, stop erection work in that area until discrepancies have been corrected.

3.3.2 Verifying Conditions and Adjacent Surfaces

After establishment of lines and grades and prior to system installation examine supporting structural elements. Verify governing dimensions, including floor elevations, floor to floor heights, minimum clearances between curtain wall and structural frames, and other permissible dimensional tolerances in the building frame.

3.3.3 Materials Embedded In Other Construction

Install materials to be embedded in cast-in-place concrete and masonry prior to the installation of the curtain wall. Provide setting drawings, templates, and instructions for installation.

3.3.4 Fastening To Construction-In-Place

Provide anchorage devices and fasteners for fastening work to construction-in-place. Provide fasteners as specified.

3.3.5 Setting Masonry Anchorage Devices

Set devices in masonry or concrete-in-place construction in accordance with the manufacturer's printed instructions. Leave drilled holes rough and free of drill dust.

3.3.6 Field-Welding Steel And Touchup Painting

Procedures of manual shielded metal arc welding, the appearance and quality of the welds made, and the methods used in correcting welding work must conform to AWS D1.1/D1.1M.

After completion of welding, clean and paint field welds and scarred surfaces on steel work and on adjacent ferrous-metal surfaces. Paint must be the same as that used for shop painting.

3.3.7 Installation Tolerances

Install curtain walls within the following tolerances:

Deviation in location from that indicated on the drawings	Plus or minus 1/4 inch
Deviation from the plumb or horizontal	
In 12 feet of length	Not more than 1/8 inch
In any total length	Not more than 1/2 inch

Offset from true alignment at joints between abutting members in line	Not more than 1/16 inch
---	-------------------------

3.3.8 Placing Curtain-Wall Framing Members

Install members plumb, level, and within the limits of the installation tolerances specified.

Connect members to building framing. Provide supporting brackets adjustments for the accurate location of curtain-wall components. Adjustable connections must be rigidly fixed after members have been positioned.

3.3.9 Panel Installation

Panels must be set with a glazing-tape back bed, two-component elastomeric sealing-compound heel bead, glazing-tape bedding of the stop, and two-component elastomeric sealing-compound topping bead on both sides of the panel. Face and edge clearances must not be less than 1/8 inch. Remove excess sealing compound on both sides of the curtain wall opening with a glazing knife at a slight angle over the rabbet leg or applied stop. Install applied stops on the exterior side of the curtain wall and secured with screws.

3.3.10 Panels

Install panels in framing member openings into framed pre-assembled units using gaskets and sealants as indicated or specified.

3.3.11 Windows

Install windows in accordance with details indicated and approved detail drawings.

3.3.11.1 Sealing

Seal exterior metal to metal joints between members of windows, frames, mullions, and mullion covers. Remove excess sealant.

3.3.11.2 Ventilators and Hardware

After installing and glazing windows, adjust ventilators and hardware to operate smoothly and to be weathertight when ventilators are closed and locked. Lubricate hardware and moving parts.

3.3.11.3 Weatherstripping

Install to make weathertight contact with frames when ventilators are closed and locked. Do not cause binding of sash or prevent closing and locking of ventilator.

Provide for ventilating sections of all windows to insure a weather-tight seal meeting the infiltration tests specified. Use easily replaceable factory-applied weatherstripping of manufacturer's stock type. Use molded vinyl, molded or molded-expanded neoprene for weatherstripping for compression contact surfaces. For sliding surfaces, use treated woven pile or wool, polypropylene or nylon pile with nylon fabric and metal or plastic backing strip weatherstripping. Do not use neoprene or polyvinyl

chloride weatherstripping where they will be exposed to direct sun light.

3.3.12 Joint Sealants

3.3.12.1 Surface Preparation

Surfaces to be primed and sealed must be clean, dry to the touch, free from frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter. Enclose joints on three sides. Clean out grooves to proper depth. Joint dimensions must conform to approved detail drawings with a tolerance of plus 1/8 inch. Do not apply compound unless ambient temperature is between 40 and 90 degrees F. Clean out loose particles and mortar just before sealing. Remove protective coatings or coverings from surfaces in contact with sealants before applying sealants or tapes. Solvents used to remove coatings must be of type that leave no residue on metals.

3.3.12.2 Applications

Match approved sample. Force compound into grooves with sufficient pressure to fill grooves solidly. Sealing compound must be uniformly smooth and free of wrinkles and, unless indicated otherwise, tooled and left sufficiently convex to result in a flush joint when dry. Do not trim edges of sealing material after joints are tooled. Mix only amount of multi-component sealant which can be installed within four hours, not to exceed 5 gallons at any given time.

3.3.12.3 Primer

Apply to masonry, concrete, wood, and other surfaces as recommended by sealant manufacturer. Do not apply primer to surfaces which will be exposed after caulking is completed.

3.3.12.4 Backing

Tightly pack in bottom of joints which are over 1/2 inch in depth with specified backing material to depth indicated or specified. Roll backing material of hose or rod stock into joints to prevent lengthwise stretching.

3.3.12.5 Bond Prevention

Install bond preventive material at back or bottom of joint cavities in which no backstop material is required, covering full width and length of joint cavities.

3.3.12.6 Protection and Cleaning

Remove compound smears from surfaces of materials adjacent to sealed joints as the work progresses. Use masking tape on each side of joint where texture of adjacent material will be difficult to clean. Remove masking tape immediately after filling joint. Scrape off fresh compound from adjacent surfaces immediately and rub clean with approved solvent. Upon completion of caulking and sealing, remove remaining smears, stains, and other soiling, and leave the work in clean neat condition.

3.3.13 Glass

Install in accordance with insulating glass manufacturer's recommendations as modified herein. Install insulating glass units made with heat

absorbing glass with heat absorbing pane on exterior side.

3.3.13.1 Inspection of Sash and Frames

Before installing glass, inspect sash and frames to receive glass for defects such as dimensional variations, glass clearances, open joints, or other conditions that will prevent satisfactory glass installation. Do not proceed with installation until defects have been corrected.

3.3.13.2 Preparation of Glass and Rabbets

Clean sealing surfaces at perimeter of glass and sealing surfaces of rabbets and stop beads before applying glazing compound, sealing compound, glazing tape, or gaskets. Use only approved solvents and cleaning agents recommended by compound or gasket manufacturer.

3.3.13.3 Positioning Glass

Set glass from inside the building unless otherwise indicated or specified. Maintain specified edge clearances and glass bite at perimeter. Maintain position of glass in rabbet and provide required sealant thickness on both sides of glass. For glass dimensions larger than 50 united inches, provide setting blocks at sill and spacer shims on all four sides; locate setting blocks one quarter way in from each jamb edge of glass. Where setting blocks and spacer shims are set into glazing compound or sealant, butter with compound or sealant, place in position, and allow to firmly set prior to installation of glass.

3.3.13.4 Setting Methods

Apply glazing compound, glazing sealant, glazing tape, and gaskets uniformly with accurately formed corners and bevels. Remove excess compound from glass and sash. Use only recommended thinners, cleaners, and solvents. Strip surplus compound from both sides of glass and tool at slight angle to shed water and provide clean sight lines. Secure stop beads in place with suitable fastenings. Do not apply compound or sealant at temperatures lower than 40 degrees F, or on damp, dirty, or dusty surfaces. After glazing, fix ventilators in sash so they cannot be operated until compound or sealant has set.

- a. Use compression gasket glazing, with compression gaskets both sides of glass and adjustable.

3.3.13.5 Void Space

Heat absorbing, insulating, spandrel, and tempered glass, and glass of other types that exceed 100 united inches in size: Provide void space at head and jamb to allow glass to expand or move without exuding the sealant.

3.3.13.6 Insulating Glass

Provide adequate means to weep incidental water and condensation away from the sealed edges of insulated glass units and out of the wall system. The weeping of lock-strip gaskets must be in accordance with the recommendation of the glass manufacturer.

3.3.13.7 Insulating Glass With Edge Bands

Insulating glass with flared metal edge bands set in lock-strip type

gaskets: Follow glass manufacturer's recommendations and add supplementary wet seal as required; when used with glazing tape, use tapered tape.

3.3.14 Firestopping

Provide firestopping , where indicated, in openings between wall system and floor at each story to prevent passage of flame and hot gases from floor to floor under extended fire exposure. Installed fire stopping must remain in place under extended fire exposure despite distortions that may occur in wall system components. Securely attach anchoring or containment devices to building structure and not to wall system. Place mineral fiber on steel plates attached to bottom of floor slab impaling chips embedded in edge of floor slab.

3.4 FINISHES

3.4.1 Galvanizing

Conform to ASTM A123/A123M, ASTM A153/A153M, and ASTM A653/A653M, as applicable.

3.4.1.1 Repair of Zinc-Coated Surfaces

Repair zinc coated surfaces damaged by welding or other means with galvanizing repair paint or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved.

3.4.2 Shop Cleaning and Painting

3.4.2.1 Cleaning

Clean steel and iron work by power wire brushing or other approved manual or mechanical means, for removal of rust, loose paint, scale, and deleterious substances. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other foreign matter, with solvents until thoroughly clean in accordance with SSPC SP 12/NACE No.5. Cleaning steel embedded in concrete is not required.

3.4.2.2 Painting Steel or Iron Surfaces

Apply one coat of primer. Apply primer to a minimum dry film thickness of 1.0 mil. Apply additional shop coat of specified paint, to which a small amount of tinting material has been added, on surfaces that will be concealed in the finished construction or that will not be accessible for finish painting. Accomplish painting in dry weather or under cover, and on steel or iron surfaces that are free from moisture and frost. Do not paint surfaces of items to be embedded in concrete. Recoat damaged surfaces upon completion of work. Prime coat steel immediately after cleaning. Do not apply bituminous protective coatings to items to be finish painted.

3.4.2.3 Painting Weathering Steel

Clean and paint surfaces which will not be exposed to the weather with one shop or field coat of specified primer, or other approved rust-inhibitive primer. Clean and strip-paint weathering steel contact surface to be covered by structural or compression gaskets or sealants with one coat to insure positive seal.

3.5 FIELD TESTS

Notify the Contracting Officer a minimum of seven calendar days prior to performing field tests. Conduct field check test for water leakage on designated wall areas after erection. Conduct test on two wall areas, two bays wide by two stories high where directed. Conduct test and take necessary remedial action as described in AAMA 501.1.

3.6 CLEANING AND PROTECTION

3.6.1 General

At the completion of the installation, clean the work to remove mastic smears and other foreign materials.

3.6.2 Manufacturer's Information

Preventive Maintenance and Inspection must consist of the aluminum manufacturer's recommended cleaning materials and application methods, including detrimental effects to the aluminum finish when improperly applied.

3.6.3 Glass

Upon completion of wall system installation, thoroughly wash glass surfaces on both sides and remove labels, paint spots, putty, compounds, and other defacements. Replace cracked, broken, and defective glass with new glass at no additional cost to the Government.

3.6.4 Aluminum Surfaces

Protection methods, cleaning, and maintenance must be in accordance with AAMA 609 & 610.

3.6.5 Other Metal Surfaces

After installation, protect windows, panels, and other exposed surfaces from disfiguration, contamination, contact with harmful materials, and from other construction hazards that will interfere with their operation, or damage their appearance or finish. Protection methods must be in accordance with recommendations of product manufacturers or of the respective trade association. Remove paper or tape factory applied protection immediately after installation. Clean surfaces of mortar, plaster, paint, smears of sealants, and other foreign matter to present neat appearance and prevent fouling of operation. In addition, wash with a stiff fiber brush, soap and water, and thoroughly rinse. Where surfaces become stained or discolored, clean or restore finish in accordance with recommendations of product manufacturer or the respective trade association.

3.7 INSPECTION AND ACCEPTANCE PROVISIONS

3.7.1 Finished Curtain-Wall System Requirements

Curtain-wall work which contains any of the following deficiencies, is unacceptable, and will be rejected:

Finish of exposed-to-view aluminum having color and appearance that are outside the color and appearance range of the approved samples.

Installed curtain-wall components having stained, discolored, abraded, or otherwise damaged exposed-to-view surfaces that cannot be cleaned or repaired.

Aluminum surfaces in contact with dissimilar materials that are not protected as specified.

3.7.2 Repair of Defective Work

Remove and replace defective work with curtain-wall materials that meet the specifications at no expense to the Government.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 71 00

DOOR HARDWARE

02/16, CHG 3: 08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY ASSURANCE
 - 1.3.1 Hardware Manufacturers and Modifications
 - 1.3.2 Installer Qualifications
 - 1.3.3 Supplier Qualifications
 - 1.3.3.1 Architectural Hardware Consultant Qualifications
 - 1.3.4 Accessibility for Disabled Persons
 - 1.3.5 Hardware for Fire Doors and Exit Doors
 - 1.3.6 Electrified Door Hardware
 - 1.3.7 Keying Conference
 - 1.3.8 Pre-Submittal Meeting
 - 1.3.9 Pre-Installation Conference
 - 1.3.10 Reference Standards
- 1.4 HARDWARE SCHEDULE
- 1.5 KEY BITTING CHART REQUIREMENTS
 - 1.5.1 Requirements
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.6.1 Delivery
 - 1.6.1.1 Cylinders, Keys and Cores
 - 1.6.1.2 Key Cabinet
 - 1.6.2 Storage
 - 1.6.3 Handling
- 1.7 WARRANTY
 - 1.7.1 Special Warranty
 - 1.7.2 Warranty Periods

PART 2 PRODUCTS

- 2.1 GENERAL HARDWARE REQUIREMENTS
 - 2.1.1 Identification
- 2.2 TEMPLATE HARDWARE
- 2.3 HARDWARE AND ACCESSORIES
 - 2.3.1 Butt Hinges
 - 2.3.1.1 Butt Hinges for Reverse Bevel Doors with Locks
 - 2.3.1.2 Butt Hinge Quantity and Sizes
 - 2.3.2 Exit Devices
 - 2.3.2.1 Coordinators
 - 2.3.2.2 Automatic Flush Bolts
 - 2.3.3 Door Controls - Closers
 - 2.3.3.1 Surface Closers
 - 2.3.3.2 Concealed Closers
 - 2.3.4 Cylinder and Input Devices for Locks
 - 2.3.4.1 Key Control Storage System

- 2.3.4.1.1 Initial Setup
- 2.3.5 Architectural Door Trim
 - 2.3.5.1 Door Protection Plates
 - 2.3.5.1.1 Armor Plates
 - 2.3.5.1.2 Kick Plates
 - 2.3.5.2 Push and Pull Plates
 - 2.3.5.3 Door Pulls
 - 2.3.5.4 Push-Pull Units
 - 2.3.5.5 Signage
- 2.3.6 Door Control - Overhead Stops and Holders
- 2.3.7 Recommended Practices for Keying Systems
- 2.3.8 Mortise Locks and Latches
 - 2.3.8.1 Lock Trim
 - 2.3.8.2 SCIF Locks
- 2.3.9 Auxiliary Hardware
 - 2.3.9.1 Manual Flush Bolts
 - 2.3.9.2 Dust-Proof Strikes
 - 2.3.9.3 Door Stops
 - 2.3.9.4 Silencers
- 2.3.10 Spring Hinges
- 2.3.11 Power Assist and Low Energy Power Operators
 - 2.3.11.1 Control Unit
 - 2.3.11.2 Actuating Devices
- 2.3.12 Thresholds
- 2.3.13 Door Gasketing and Edge Seal Systems
 - 2.3.13.1 Lightproofing and Soundproofing
 - 2.3.13.2 Aluminum Housed Weather-Stripping
 - 2.3.13.3 Gasketing
 - 2.3.13.3.1 Smoke Seals
- 2.3.14 Electrified Locking Devices
- 2.3.15 Continuous Hinges
- 2.3.16 Lock Cylinders
 - 2.3.16.1 Interchangeable Core Design
 - 2.3.16.2 Permanent Cores
- 2.3.17 Exit locks, Exit Alarms, Alarms for Exit Devices
- 2.3.18 Power Transfer Pivots
- 2.3.19 Balanced Magnetic Switches
- 2.3.20 Special Tools
- 2.4 FASTENERS
- 2.5 FINISHES
- 2.6 KEYING SYSTEM
- 2.7 KEY CABINET AND CONTROL SYSTEM

PART 3 EXECUTION

- 3.1 COORDINATION
- 3.2 INSTALLATION
 - 3.2.1 Hardware for Fire Doors and Smoke-Control Door Assemblies
 - 3.2.2 Electrified Hardware
 - 3.2.3 Hinges
 - 3.2.4 Door-Closing Devices
 - 3.2.5 Door Stops
 - 3.2.6 Kick Plates and Armor Plates
 - 3.2.7 Cylinders
 - 3.2.8 Thresholds
 - 3.2.9 Weather-Stripping, Lightproofing and Soundproofing
 - 3.2.10 Gasketing
 - 3.2.11 Key Control Storage System
- 3.3 HARDWARE MOUNTING HEIGHTS

- 3.4 OPERATIONAL TESTS
- 3.5 FIELD QUALITY CONTROL
- 3.6 HARDWARE SETS

-- End of Section Table of Contents --

SECTION 08 71 00

DOOR HARDWARE

02/16, CHG 3: 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 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	(2016) Butts and Hinges
ANSI/BHMA A156.3	(2020) Exit Devices
ANSI/BHMA A156.4	(2013) Door Controls - Closers
ANSI/BHMA A156.5	(2020) Cylinder and Input Devices for Locks
ANSI/BHMA A156.6	(2015) Architectural Door Trim
ANSI/BHMA A156.7	(2016) Template Hinge Dimensions
ANSI/BHMA A156.8	(2021) Door Controls - Overhead Stops and Holders
ANSI/BHMA A156.11	(2014) Cabinet Locks
ANSI/BHMA A156.13	(2017) Mortise Locks & Latches Series 1000
ANSI/BHMA A156.16	(2018) Auxiliary Hardware
ANSI/BHMA A156.17	(2019) Self Closing Hinges & Pivots
ANSI/BHMA A156.18	(2020) Materials and Finishes
ANSI/BHMA A156.19	(2013) Power Assist & Low Energy Power Operated Doors
ANSI/BHMA A156.21	(2019) Thresholds
ANSI/BHMA A156.22	(2017) 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

DOOR AND HARDWARE INSTITUTE (DHI)

ANSI/DHI A115.1G	(1994) Installation Guide for Doors and Hardware
ANSI/DHI A115W	(2006) Wood Door Hardware Standards (A115-W, A115-W4 & A225-W8)
DHI-2	(1996) Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames
DHI-3	Abbreviations and Symbols

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 80	(2019) Standard for Fire Doors and Other Opening Protectives
NFPA 101	(2021) Life Safety Code
NFPA 105	(2019) Standard for Smoke Door Assemblies and Other Opening Protectives
NFPA 252	(2017) Standard Methods of Fire Tests of Door Assemblies

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines
-------------	---

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

Hardware Devices

Detail drawings for hardware devices for computerized keying

systems, push button access control systems, and other electrical hardware devices showing complete wiring and schematic diagrams and other details required to demonstrate proper function of units.

Hardware Schedule; G

Keying System; G

Wiring Diagram; G

SD-03 Product Data

Hardware and Accessories; G

Manufacturer's descriptive data, technical literature, catalog cuts, and installation instructions. Spare parts data for locksets, exit devices, closers, electric locks, electric strikes, closer holder release devices, and electric exit devices, after approval of the detail drawings, and not later than three months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-08 Manufacturer's Instructions

Installation Instructions and Hardware Device Templates

SD-10 Operation and Maintenance Data

Hardware Schedule Items, Data Package 1; G

Furnish one Compact Disk containing the Operation and Maintenance information. Coordinate delivery with the post-installation job site meeting. The disk shall be clearly labeled with the project name on the front. Include the following in clearly identified individual PDF files:

- a. Maintenance instructions for each item of hardware supplied.
- b. Copy of the final Door Hardware Schedules for all doors.
- c. Current catalogs for each Hardware Manufacturer provided.
- d. Names and phone numbers of the factory representatives for each Hardware Product Line supplied.
- e. Copy of the final Keying Schedule.
- f. Copy of the final Wiring Diagrams.

Maintenance Tools: Furnish a complete set of specialized tools as needed for the Government's continued adjustment, maintenance, removal and replacement of door hardware.

SD-11 Closeout Submittals

Key Bitting

Warranty; G

Special warrantees specified in this Section.

1.3 QUALITY ASSURANCE

1.3.1 Hardware Manufacturers and Modifications

Obtain each kind of hardware (latches and locksets; closers; power operators; exit devices; etc.) from one manufacturer. Hardware modifications necessary to provide features indicated or specified shall be done at the factory. Furnish hardware items of proper design for use on doors and frames of thickness, profile, swing, security and similar requirements indicated as necessary for proper installation and function.

1.3.2 Installer Qualifications

Assign the installation of hardware to tradesmen experienced in the installation of commercial door hardware. Hardware Installers shall be trained and certified by the Lock, Door Closer, and Exit Device Manufacturers.

1.3.3 Supplier Qualifications

Nationally recognized architectural door hardware supplier, with warehousing facilities, who has been furnishing hardware in the Project's vicinity for a period of not less than two years.

- a. Supplier's responsibilities include supplying and installing door hardware. Supplier must employ an Architectural Hardware Consultant who shall be available during the course of the Work to consult with Contractor and Contracting Officer about door hardware.
- b. Scheduling Responsibility: Preparation of door hardware and keying schedules.

1.3.3.1 Architectural Hardware Consultant Qualifications

A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware scheduling, distribution and installations that are comparable in material, design, and extent to that indicated for this Project. Consultant must be knowledgeable in electrified components and systems and be able to produce wiring diagrams for review and consultation as needed.

1.3.4 Accessibility for Disabled Persons

Special hardware requirements for knurling, slow acting closers or other barrier free opening requirements shall be provided as indicated in the Hardware Set Schedule and as required to comply with the U.S. Department of Justice's "ADA Standards for Accessible Design" and "Architectural Barriers Act". Provide documentation of ADA/ABA accessibility compliance of applicable components, as required by 36 CFR 1191 Appendix D - Technical.

1.3.5 Hardware for Fire Doors and Exit Doors

Hardware for fire doors shall conform to NFPA 80; hardware for exit doors shall conform to NFPA 101. Other requirements specified shall also apply. Such hardware shall comply with the applicable UL standards for the intended use specified and be listed in UL Bld Mat Dir, or be labeled and listed by another testing laboratory deemed acceptable by the Contracting

Officer.

- a. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to Authorities Having Jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
- b. Test Pressure: After five minutes into the test, neutral pressure level in furnace shall be established at 40-inches or less above the sill.

1.3.6 Electrified Door Hardware

Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to Authorities Having Jurisdiction, and marked for intended use.

1.3.7 Keying Conference

Coordinate and attend a keying meeting at the jobsite with the COTR, Government, Hardware Subcontractor's AHC, Base Locksmith and other parties deemed appropriate.

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
- b. Scheduling Responsibility: Preparation of door hardware schedules.
 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 2. Preliminary key system schematic diagram.
 3. Requirements for key control system.
 4. Address for delivery of permanent keys and cores.

1.3.8 Pre-Submittal Meeting

Prior to submittal of the Hardware Schedules, coordinate and attend a pre-submittal meeting at the jobsite with the COTR, Government and other parties deemed appropriate. This meeting shall determine partial submittals that will be acceptable and coordination between suppliers of components. All issues and concerns, alternate methods, sequencing, etc. shall be dealt with at this meeting.

1.3.9 Pre-Installation Conference

Conduct conference at Project site. Review methods and procedures related to door hardware installation including, but not limited to, the following:

- a. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
- b. Review sequence of operation for each type of electrified door hardware.
- c. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to

make progress and avoid delays.

- d. View required testing, inspecting, and certifying procedures.

1.3.10 Reference Standards

Except as otherwise required by governing authorities or Contract Documents, comply with applicable provisions of the Door and Hardware Institute.

1.4 HARDWARE SCHEDULE

Based on hardware indicated, organize hardware schedule into Sets or Headings showing complete designations of every item required for each door opening. Schedule shall be vertical layout similar to the format used herein. Lines shall be double spaced with pages numbered and dated.

- a. For doors of different sizes or where hinges, locks or closers are different, a separate heading shall be used. No labeled openings shall be combined with non-labeled openings. Horizontal hardware schedules are not acceptable. Include the following:
 - 1. Number, location, hand, fire rating, size and material of each door opening (hands and swings to be determined in relation to key side of opening).
 - 2. Type, style, function, size, finish and quantity of each hardware item.
 - 3. Name and manufacturer of each item.
 - 4. Fastening requirements.
 - 5. List of abbreviations used, conforming to DHI-3.
 - 6. Special mounting locations and instructions.
- b. Combined submittals are not acceptable. Do not combine hardware schedules with door and frame shop drawings.
- c. Furnish an index cross referencing Contract Document door number and Hardware Set, and Supplier's Hardware Set or Heading.

1.5 KEY BITTING CHART REQUIREMENTS

1.5.1 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 (e.g. 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.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver door hardware to the Contractor. Direct factory shipments (drop shipments) to the job site are not acceptable. Deliver items of hardware at the proper times to the proper locations (shop or project site).

Deliver hardware to the project site in the manufacturer's original packages. Each article of hardware shall be individually packaged in the manufacturer's standard commercial carton or container, and shall be properly marked or labeled to be readily identifiable with the approved hardware schedule. Manufacturer's printed installation instructions, fasteners, and special tools shall be included in each package.

1.6.1.1 Cylinders, Keys and Cores

Furnish cylinders, construction master keys and temporary cores to Contractor when locks are delivered, for use during construction. Prior to the scheduled completion of the project, manufacturer shall ship all permanent keys and cores directly to the Contracting Officer via Registered Mail, Return Receipt Requested or other pre-approved means. Under no circumstance shall any permanent keys or cores be furnished direct to the Contractor.

1.6.1.2 Key Cabinet

Deliver key cabinet to the Contracting Officer prior to building occupancy.

1.6.2 Storage

A dry, locked storage space complete with adequate shelving shall be set aside for the purpose of unpacking, sorting out, checking and storage.

Control the handling and installation of hardware items, whether immediately replaceable or not, so completion of the work will not be delayed by losses before or after installation. Tag each item or package separately, with identification related to the final approved hardware schedule, and include basic installation instructions in the package.

1.6.3 Handling

Representatives of the Contractor and the Hardware Supplier shall jointly inventory the door hardware. Replace items damaged in shipment promptly and with proper material without additional cost to the Contractor. Handle all hardware in a manner to eliminate marring, scratching or damage.

1.7 WARRANTY

1.7.1 Special Warranty

Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fails in materials or workmanship within specified warranty period.

a. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.

2. Faulty operation of operators and door hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

1.7.2 Warranty Periods

- a. Hinges: Life of the installation.
- b. Manual Closers: Twenty-five years from date of Substantial Completion.
- c. Continuous Hinges: Ten years from date of Substantial Completion.Exit Devices and Locksets:
 1. Mechanical: Five years from date of Substantial Completion.
 2. Electrified: Two years from date of Substantial Completion.
- d. All other hardware items: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 GENERAL HARDWARE REQUIREMENTS

Hardware shall conform to the requirements specified herein and the HARDWARE SETS listing at the end of this section. Hardware sets numbers correspond to the set numbers shown on the drawings. Where ANSI/BHMA numbers are not available, manufacturers and products are named only for the purpose of establishing a standard of quality and design and are in no way to be construed as limiting competition.

2.1.1 Identification

Clearly and permanently mark with the manufacturer's name or trademark, hinges, locks and latches, exit devices, bolts, strikes, closers and power operators where the identifying mark is visible after the item is installed. For closers and power operators the name or trademark may be beneath the cover.

2.2 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.

2.3 HARDWARE AND ACCESSORIES

2.3.1 Butt Hinges

Conform to ANSI/BHMA A156.1. Butt hinges used on metal doors and frames shall also conform to ANSI/BHMA A156.7. Butt hinges for labeled doors shall comply with the requirements of NFPA 80.

2.3.1.1 Butt Hinges for Reverse Bevel Doors with Locks

Furnish non-removable pins (NRP) for all reverse bevel doors receiving

keyed locks, rigid outside trim or "exit only" hardware. All butt hinges shall have holes in the bottom plug to facilitate pin removal.

2.3.1.2 Butt Hinge Quantity and Sizes

Furnish two butt hinges for doors 60-inches or less in height and one additional butt hinge for each additional 30-inches of height or fraction thereof. Unless otherwise specified, butt hinges for doors through 36-inches wide shall be 4.5 x 4.5; hinges for doors over 36-inches wide shall be heavyweight 5 x 4.5.

2.3.2 Exit Devices

Conform to ANSI/BHMA A156.3, Grade 1. Trim shall be of wrought construction and commercial plain design with straight, beveled, or smoothly rounded sides, corners and edges. Adjustable strikes shall be provided for rim type and vertical rod devices. Touch bars shall be provided in lieu of conventional crossbars and arms. Where lever handle functions are required, they shall match the design and construction of lever handles specified for locks and latches. Provide strike boxes with all strike plates.

2.3.2.1 Coordinators

Coordinators shall be Type 21A, stop-mounted and extend the full width of the opening. Equip units with safety release mechanisms that allow the active door to close if under undue pressure. Coordinators shall be mechanically operated and capable of holding the active door of a pair open until the inactive door has preceded it in the closing cycle. When used as fire exit hardware, coordinators shall be listed or labeled by a nationally recognized independent testing laboratory. Include necessary closer brackets, cutouts and filler bars as required.

2.3.2.2 Automatic Flush Bolts

Automatic flush bolts shall be Type 27 and shall be installed at the top and bottom of the inactive leaf of pairs of fire rated doors where specified in the hardware sets. Flush bolts shall be mortised in the strike edge of the door.

2.3.3 Door Controls - Closers

Conform to ANSI/BHMA A156.4, Grade 1. Closing devices shall be products of one manufacturer for each type specified. The opening resistance of closing devices shall not exceed 15-pounds applied at the latch stile or exceed 5-pounds where low opening resistance is scheduled or required.

2.3.3.1 Surface Closers

Surface type closers shall be Grade 1, Series C72001 (cast iron) with full cover and Options PT-4D and PT4H (size one through four). Closers shall have 1 1/2-inch diameter steel pistons with minimum 5/8-inch heat-treated shafts. Closers shall be installed on the least conspicuous side of the door or the side opposite public view. Closer arms shall be forged. Where parallel arms are required, furnish solid-steel two-piece units.

2.3.3.2 Concealed Closers

Concealed closers shall be Grade 1, Series C75041 (cast iron) with Options

PT-4D and PT4H (size one through four). Closers shall have 1 1/2-inch diameter steel pistons with minimum 5/8-inch heat-treated shafts. Closer arms shall be forged.

2.3.4 Cylinder and Input Devices for Locks

Conform to ANSI/BHMA A156.5.

2.3.4.1 Key Control Storage System

Provide a key control system including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers and standard metal cabinet with capacity for 150% of the number of cylinders required for the Project. Equip with pin tumbler locking mechanism and three keys.

2.3.4.1.1 Initial Setup

Furnish a complete cross-index system set up by the key control manufacturer.

2.3.5 Architectural Door Trim

Conform to ANSI/BHMA A156.6.

2.3.5.1 Door Protection Plates

Protection plates shall be 0.050-inch thick with four beveled edges. Width shall be 1 1/2-inches less than the door width for single doors and 1-inch less for pairs of doors.

2.3.5.1.1 Armor Plates

Armor plates shall be Type J101. Unless otherwise indicated or where narrow bottom rails dictate a smaller size, height shall be 34-inches. Armor plates on labeled doors shall comply with the requirements of NFPA 80.

2.3.5.1.2 Kick Plates

Kick plates shall be Type J102. Unless otherwise indicated or where narrow bottom rails dictate a smaller size, height shall be 10-inches.

2.3.5.2 Push and Pull Plates

Push and pull plates shall be Type J302, 1/8-inch thick with four beveled edges. Plates shall be 4-inches wide and 16-inches high.

2.3.5.3 Door Pulls

Door pulls shall be Type J401, fabricated from 1-inch round solid bar stock. Unless otherwise indicated in paragraph HARDWARE SETS, pulls shall be 10-inches center-to-center.

2.3.5.4 Push-Pull Units

Push-pull units shall be fabricated from 1 1/4-inch round bar stock. Units shall be mounted back-to-back with concealed fastening. Refer to paragraph HARDWARE SETS for style.

2.3.5.5 Signage

Stainless steel signs mounted on door, engraved with block capital letters 1-inch in height.

- a. Alarmed Exit Sign: Two centered lines reading:
EMERGENCY EXIT ONLY
SECURITY WILL BE ALERTED
- b. Fill lettering with red enamel paint.
- c. Sign shall be located above and within 12-inches of the exit/actuation device.

2.3.6 Door Control - Overhead Stops and Holders

Conform to ANSI/BHMA A156.8. Where wall or floor stops are not suitable, provide concealed overhead stops Type C14541.

2.3.7 Recommended Practices for Keying Systems

Conform to ANSI/BHMA A156.11. Temporary cores shall be keyed-alike. Furnish keys in following quantities:

- a. Control keys (for removal of cores): Five.
- b. Construction master keys: Twenty.

2.3.8 Mortise Locks and Latches

To the maximum extent possible, locksets, latchsets and deadlocks shall be the products of a single manufacturer. For each lock and latch, provide strike box and square corner ASA strike with curved lips of sufficient length to protect frames.

Conform to ANSI/BHMA A156.13, operational Grade 1, and Series 1000. Strikes for pairs of doors shall be rectangular without curved lip. Locks and latches shall have adjustable bevel fronts or otherwise conform to the shape of the door. Mortise locks shall have armored fronts.

2.3.8.1 Lock Trim

Lever handles of solid or cast design equal to Best Access Systems #16S.

2.3.8.2 SCIF Locks

Conform to Federal Standards FF-L-2890B and FF-L-2740.

2.3.9 Auxiliary Hardware

Conform to ANSI/BHMA A156.16.

2.3.9.1 Manual Flush Bolts

Manual flush bolts shall be Type L14081. Top manual flush bolts shall not exceed 74-inches from floor to centerline.

2.3.9.2 Dust-Proof Strikes

Dust-proof strikes shall be Type L14021. At doors receiving thresholds and flush bolts, furnish dust-proof strikes without faceplates.

2.3.9.3 Door Stops

Unless otherwise indicated in the paragraph HARDWARE SETS, furnish Type L12101 cast wall stops wherever trim strikes wall. Where wall stops are not suitable, furnish Type L12141 (with manufacturer's standard removable riser) floor stops.

2.3.9.4 Silencers

Silencers shall be Type L03011 for metal frames. Provide three for single doors and two for pairs of doors. Silencers are not required aluminum frames or at doors receiving continuous weather-stripping or seals.

2.3.10 Spring Hinges

Conform to ANSI/BHMA A156.17.

2.3.11 Power Assist and Low Energy Power Operators

Conform to ANSI/BHMA A156.19. Units shall be electro-mechanically operated and surface mounted to frame head. Operators shall function as normal door closers until operator is activated and when power is lost. Activation of operator shall open door leaf to 90-degrees. Supplier shall be responsible for all system's configuration.

2.3.11.1 Control Unit

Micro-processor controlled.

Provide adjustable opening speed, adjustable backcheck speed, adjustable closing speed, and adjustable hold-open period.

Provide built-in 3-position switch for "OFF", "ON" and "HOLD-OPEN" operation and to deactivate actuator switches.

Provide safety-stop feature: If object or obstruction is encountered during opening and/or closing cycles, door operator stops and slowly returns to closed or open position respectively.

Provide with safety circuit so that if actuator switch is activated when door is latched or locked, power operator resets without operator and/or door damage.

Accessories: Furnish complete with fastenings, fittings, and other accessories as required for a complete installation.

Manufacturer shall provide detailed Wiring Diagrams showing point-to-point hook-up of all components affected (e.g., access control system, operators, actuators, power, etc.). Coordinate electrical connection and installation with Divisions 26 and 28.

2.3.11.2 Actuating Devices

Provide 4-1/2" x 2-3/4" wall-mounted, and 1-3/4" wide jamb-mounted

hands-free actuator switches as indicated, weatherproof as required.

- a. Actuators shall operate on 24VDC provided by operator.
- b. Engrave "WAVE TO OPEN" and the Universal Accessibility Symbol on plate.

2.3.12 Thresholds

Conform to ANSI/BHMA A156.21. Thresholds shall be aluminum of the type indicated and shall provide proper clearance and an effective seal with specified weather stripping/seals. Where required, field-modify thresholds to receive projecting bolts of flush bolts and exit devices. Thresholds shall be beveled with slopes not exceeding 1:2 and with heights not exceeding 1/2-inch. Latching thresholds shall conform to ANSI/BHMA A165.3, Type 26, and of such height that the bottom of the door shall be 1/8-inch over the tread of the threshold and 1/8-inch below the top of the stop.

2.3.13 Door Gasketing and Edge Seal Systems

Conform to ANSI/BHMA A156.22.

2.3.13.1 Lightproofing and Soundproofing

A set shall include gasketing at the head and jambs, one automatic door bottom (per door leaf) and a meeting stile gasket (at pairs of doors only). Metallic items shall be constructed of extruded aluminum with a clear anodized finish.

2.3.13.2 Aluminum Housed Weather-Stripping

Weather-stripping shall consist of extruded aluminum retainers not less than 0.08-inch wall thickness with neoprene inserts. Aluminum shall be clear anodized. Weather-stripping material shall be of an industrial/commercial grade. Seals shall remain functional through all weather and temperature conditions. Air leakage rate of weather-stripping shall not exceed 0.775 liters per second per lineal meter of crack when tested in accordance with ASTM E283 at standard test conditions.

2.3.13.3 Gasketing

Compression type seal, silicon based, self-adhesive product for use on steel door frames with wood or steel doors for 20-minute, 45-minute C-label and 90-minute B-label. Color shall be black. Air leakage rate of gasketing shall not exceed 0.775 liters per second per lineal meter of crack when tested in accordance with ASTM E283 at standard test conditions.

2.3.13.3.1 Smoke Seals

At all fire-rated wood doors and at all doors required to be 'smoke resistant', provide the following:

- a. Head and Jambs: R0E154.
- b. Meeting Stile at Pairs: Overlapping astragal seals equal to Pemko #375CR or two R3E735 as appropriate for intended hardware operation.
- c. Refer to the Drawings for locations.

2.3.14 Electrified Locking Devices

Conform to ANSI/BHMA A156.25. Locks and exit devices specified to be electrified shall have outside trim factory-modified to Electrically Unlock (FSE) upon receipt of a 24VDC signal and will remain in this mode until signal is interrupted.

Exit devices indicated to have electric latch retraction (ELR) shall be modified to electrically unlatch (dog down) upon receipt of a 1.0 amp, 24VDC signal and will remain unlatched until signal is interrupted.

Electrified locks and exit devices shall have internal SPDT contacts (RX) for remote signaling of operation of the inside lever handle or push pad. Switches shall be used in conjunction with the Access Control System to accommodate "authorized egress".

Field-connect electrified locking hardware to associated power transfer units. Coordinate installation and electrical connection with Division 28.

2.3.15 Continuous Hinges

Conform to ANSI/BHMA A156.26. Geared-Type, extruded aluminum leaves with interlocking cover and nylon bearings.

Continuous geared hinges shall consist of two full height bearing levers, geared together for the full length of the hinge and joined with a cover channel.

Continuous geared hinges are to be heavy duty type with a minimum of 32 bearings up to 84-inches in height. Bearings are to be completely concealed in a full cover channel.

2.3.16 Lock Cylinders

Conform to ANSI/BHMA A156.30. Furnish all locking hardware with cylinders.

2.3.16.1 Interchangeable Core Design

Provide cylinders for new locks, including locks provided under other sections of this specification. Cylinders shall be of an interchangeable core design. Furnish brass temporary cores for use during construction; plastic inserts are not acceptable. Paint all temporary cores red. Temporary cores shall be of the same manufacturer as the cylinder housing. Cylinders shall accept Government-furnished MANUFACTURER, MAKE & MODEL TO BE DETERMINED.

2.3.16.2 Permanent Cores

Permanent cores will be Government-furnished and -installed. Upon completion of the Project, temporary cores will be removed by the Government and returned to the Contractor. Temporary cores shall remain the property of the manufacturer.

2.3.17 Exit locks, Exit Alarms, Alarms for Exit Devices

Conform to ANSI/BHMA A156.29.

2.3.18 Power Transfer Pivots

Concealed PTFE-jacketed wires, secured at each leaf and continuous through sleeve. Field-connect power transfer units to associated electrified locking hardware. Coordinate electrical connection and installation with Division 28.

2.3.19 Balanced Magnetic Switches

Concealed magnetic switches shall be Magnashpere #MSS-300C. Doors and frames must be factory-machined to receive concealed switches without field-modification. Surface-mounted magnetic switches are provided by the Security System Integrator (Division 28).

2.3.20 Special Tools

Four sets of special tools, such as those supplied by the manufacturer, unique wrenches, and dogging keys, shall be furnished to the Contracting Officer as required to service and adjust hardware items.

2.4 FASTENERS

Fastenings of proper type, size, quantity, and finish shall be supplied with each article of hardware. Machine screws and expansion shields shall be used for attaching hardware to concrete or masonry. Fastenings exposed to the weather in the finished work shall be stainless steel. Sex bolts, through bolts, or machine screws and grommet nuts, where used on exterior doors, shall employ one-way screws or other approved tamperproof screws. Where wood screws are required, they shall be full thread (to the head) type. All push, kick and armor plates shall be furnished with Phillips undercut, countersunk screws per ANSI/BHMA A156.6; trusshead screws are not acceptable.

Hardware Installers are NOT to use power drills or impact drivers to install screws for door hardware, set screws, face plate screws, trim screws, etc.

2.5 FINISHES

Produce hardware units of basic metal and forming method indicated, using manufacturers standard metal alloy composition, temper and hardness, but in no case of lesser quality than specified or inferred by use of a particular manufacturer's number, style or grade or as established by appropriate referenced specification listed herein.

Finishes shall conform to the quality of finish including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than the standards established by ANSI/BHMA A156.18. Where painting of primed surfaces is required, refer to Division 09 specifications.

All exposed hardware except surface closers and hinges be satin stainless steel, ANSI/BHMA 630/US32D. Surface closers and power operators shall be factory-finished to match satin stainless steel. Butt hinges on interior doors shall be satin chrome plated, ANSI/BHMA 652/US26D; butt hinges on exterior doors and doors in wet areas shall be satin stainless steel. Continuous geared hinges shall be factory-finished to match storefront, coordinate with Section 08 41 00 for color. Items of hardware not available in stainless steel shall be furnished with a stain chrome finish.

2.6 KEYING SYSTEM

Detailed keying system schedule, indicating Government's approved keying system, for Government review and approval. Include the following:

- a. Schematic keying diagram.
- b. Index identifying each key set to unique door designations.
- c. Bitting list.

Wiring Diagrams:

After Hardware Schedule has received Government's approval; submit the following:

- a. Details of electrified door hardware and hardware devices. Include fire alarm and/or access control system interface where applicable.
- b. Diagrams shall be complete by opening and shall indicate connections between all components affected. Manufacturers' standard line diagrams are not acceptable. Include the following:
 1. System schematic.
 2. Point-to-point wiring diagram.
 3. Riser diagram.
 4. Elevation of each door.
- c. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

2.7 KEY CABINET AND CONTROL SYSTEM

Provide in accordance with ANSI/BHMA A156.5, Type required to yield a capacity (number of hooks) 50 percent greater than the number of key changes used for door locks.

PART 3 EXECUTION

3.1 COORDINATION

Coordinate Door Hardware Schedule submission and hardware ordering to ensure delivery of all items as directed by the Contractor.

- a. Prior to ordering any hardware, examine the shop drawings and details of doors and frames and other substrate suppliers to determine that the proper type and size pieces of hardware are being furnished. No extra for material or labor will be allowed for any corrections that should have been eliminated by proper prior coordination.

Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies, fire alarm system and detection devices, and access control system.

- a. Coordinate installation of the electronic hardware with the Architect and Electrical Engineers and provide installation and technical data to the Installer and other related sub-contractors.
- b. Coordinate electronic security hardware components with corresponding components specified in Division 28.

3.2 INSTALLATION

Application shall be in accordance with ANSI/DHI A115.1G or ANSI/DHI A115W. Door control devices for exterior doors such as closers and holders, shall be attached to doors with thru bolts and nuts or sex bolts. The Contracting Officer may approve alternate fastening methods when manufacturers' documentation is submitted to verify that the fastening devices and door reinforcements are adequate to resist wind induced stresses. All hardware items shall be installed in accordance with manufacturers' printed installation procedures.

3.2.1 Hardware for Fire Doors and Smoke-Control Door Assemblies

Install in accordance with the requirements of NFPA 80. Exit devices installed on fire doors shall have a visible label bearing the marking "Fire Exit Hardware". Other hardware installed on fire doors, such as locksets, closers, and hinges shall have a visible label or stamp indicating that the hardware items have been approved by an approved testing agency for installation on fire-rated doors. Hardware for smoke-control door assemblies shall be installed in accordance with NFPA 105.

3.2.2 Electrified Hardware

Pre-wire and make field connections between all electrically operated and hardware items including, but not limited to, power operators and electrified locking hardware. All wiring must be 18 gauge or thicker. Power Operators:

- a. Installer to adjust and calibrate opening, closing and latching speeds. All operators shall be set to hold doors open for 90 seconds.
- b. At openings equipped with access control devices, coordinate operator installation with Security System Integrator.

3.2.3 Hinges

Install steel doors and wood doors to comply with reference standards, as specified in door sections. Where shimming is required to comply with tolerances, provide metal shims only.

3.2.4 Door-Closing Devices

Install and adjust in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door.

Adjust closers to control door swing and to provide positive latching of doors. Adjust closers not to exceed following manual opening forces:

- a. Exterior doors: As required to close and latch each leaf.

- b. Interior doors (non-fire-rated): Maximum 5-pounds opening force.
- c. Fire-rated doors: As required to close and latch each leaf.

3.2.5 Door Stops

Install stops for maximum degree of door opening swing allowed by conditions of installation. Locate floor stops so as not to create a tripping hazard. Locate wall stops centered on spindle of lever handles; coordinate with partition installer to ensure proper blocking is provided wherever wall stops are to be installed.

3.2.6 Kick Plates and Armor Plates

Install on the push side of single-acting doors and on both sides of double-acting doors.

3.2.7 Cylinders

The Government will remove temporary cylinder cores and install permanent cylinders. Turn over all construction keys to the Contracting Officer; the Government will retain all temporary cylinder cores and construction keys.

3.2.8 Thresholds

Secure with a minimum of three fasteners per single door width and six fasteners per double door width with a maximum spacing of 12-inches. Exterior thresholds shall be installed in a bed of sealant with expansion anchors and stainless steel screws. Minimum screw size shall be No. 10 length, dependent on job conditions, with a minimum of 3/4-inch thread engagement into the floor or anchoring device used.

3.2.9 Weather-Stripping, Lightproofing and Soundproofing

Locate as indicated, snug to door face and fastened in place with color matched metal screws after door and frames have been finish painted. Screw spacing shall be as recommended by manufacturer.

3.2.10 Gasketing

Install at the inside edge of the hinge and head and latch sides of door frame per manufacturer's instructions. Frames shall have tolerance for a 1/8-inch clearance between door and frame. Frames shall be treated with tape primer prior to installation.

3.2.11 Key Control Storage System

Deliver key cabinet to the Contracting Officer prior to building occupancy. Install in accordance with manufacturer's instructions in location as directed. Include documentation of keying compliance including copies of signed transmittals for all building keys, cores and cabinets provided.

3.3 HARDWARE MOUNTING HEIGHTS

Conform to DHI-2 except as otherwise indicated or required to comply with governing regulations. When approved, slight variations in locations or dimensions will be permitted.

3.4 OPERATIONAL TESTS

Prior to acceptance of any electrical hardware system, an operational test shall be performed to determine if devices are operating as intended by the specifications. Wiring shall be tested for correct voltage, current carrying capacity, and proper grounding. Stray voltages in lock wiring shall be eliminated to prevent locking devices from releasing in critical situations.

3.5 FIELD QUALITY CONTROL

Inspect the completed door hardware installation and certify that the hardware has been furnished and installed in accordance with the manufacturers' instructions and as specified. The inspection report shall identify any malfunctioning items and recommend adjustment or replacement as appropriate.

3.6 HARDWARE SETS

-- End of Section --

JCC BUCKLEY HARDWARE SETS

Description of Work: The following set schedule is to be used with Drawings as a guide for furnishing door hardware. Set numbers specified correspond to set numbers indicated on Drawings. Schedules do not reflect hand, backset (except as noted) or method of fastening of hardware items.

Set 113

- Hinges A5112
- 1 Privacy function latchset, F22 with Occupied Indicator
- 1 Surface closer C02011
- 1 Coat hook L13111
- 1 set Sound seals R0E154 - Head & Jambs
- 1 Threshold (by Flooring Contractor)
- 1 Automatic door bottom R3C346
- 1 Stop (wall or floor as required)

Set 210

- Hinges A5111
- 1 Push plate J302
- 1 Pull J401 (TB pull fasteners & conceal under push plate)
- 1 Surface closer C02011
- 1 Kick plate J102
- 1 Stop (wall or floor as required)

Set 316

- Hinges A8112
 - 1 Electrified exit device, Type 3-F09 x RX x FSE (US32D strike)
 - 1 Cylinder & core
 - 1 Surface closer C02021
 - 1 set Sound seals R0E154 - Head & Jambs
 - 1 Threshold J32330 x 75 mm
 - 1 Automatic door bottom R3C336
 - 1 Power transfer pivot (equal to Securitron #CEPT-10)
 - 1 Concealed magnetic switch - Magnasphere # MSS-300C
 - 1 Card reader (by Security System Integrator)
 - 1 Power supply (by Security System Integrator)
 - 1 Stop (wall or floor as required)
- Function: Card reader shunts magnetic switch and releases electrified lever trim. Depressing crash bar shunts magnetic switch. Door position status monitored through Access Control System.

Set 320

- Hinges A8111
- 1 Passage function exit device, Type 8-F14 x less bottom rod
- 1 Exit only exit device, Type 8-F01 x less bottom rod
- 2 Surface closers C02011
- 2 Kick plates J102
- 2 Stops (wall or floor as required)

Set 321

- Hinges A5112
- 1 Electrified exit device, Type 1-F09 x RX x FSE
- 1 Exit only electrified exit device, Type 1-F01 x RX
- 1 Cylinder & core
- 1 Key-removable mullion, Type 22 with stabilizer - field-paint to match frame
- 1 Cylinder & core (for mullion)
- 2 Surface closers C02021 (with built-in stop)
- 2 Closer mounting brackets (equal to Zero #328SPB) - field-paint to match frame
- 2 Kick plates J102
- 1 set Weather-stripping R3B165 - Head & Jambs
- 1 Threshold J36139
- 1 set Meeting stile gaskets R3E735
- 2 Sill sweeps R3B416
- 2 Power transfer pivots (equal to Securitron #CEPT-10)
- 2 Concealed magnetic switches - Magnasphere # MSS-300C
- 1 Card reader (by Security System Integrator)
- 1 Power supply (by Security System Integrator)

Function: Card reader shunts magnetic switches and releases electrified lever trim. Depressing either crash bar shunts magnetic switch. Door position status monitored through Access Control System.

Set 322

- Hinges A5112
- 2 Exit only exit devices (Type 1-F01) with integral battery-powered embarrassment alarms, E0411
- 2 Cylinders & cores (for embarrassment alarms)
- 1 Key-removable mullion, Type 22 with stabilizer - field-paint to match frame
- 1 Cylinder & core (for mullion)
- 2 Surface closers C02021 (with built-in stop)
- 2 Closer mounting brackets (equal to Zero #328SPB) - field-paint to match frame
- 2 Alarmed exit signs x CSK (see Paragraph 2.3.5.5)
- 1 set Weather-stripping R3B165 - Head & Jambs
- 1 Threshold J36139
- 1 set Meeting stile gaskets R3E735
- 2 Sill sweeps R3B416
- 2 Concealed magnetic switches - Magnashpere #MSS-300C
- 1 Power supply (by Security System Integrator)

Function: Depressing crash bar sounds audible alarm. Door position status monitored through Access Control System.

Set 323

- Hinges A5112
- 1 Storeroom function exit device, Type 3-F09 (US32D strike)
- 1 Cylinder & core
- 2 Manual flush bolts L14081
- 1 Dust strike L14021
- 2 Surface closers C02021 (with built-in stop & mechanical hold-open)
- 2 Closer mounting brackets (equal to Zero #328SPB) - field-paint to match frame

1 set Weather-stripping R3B165 - Head & Jambs
 1 Threshold J36139
 1 Overlapping astragal weather-strip (equal to Pemko #375CR)
 2 Concealed magnetic switches - Magnashpere #MSS-300C
 2 Balanced magnetic switches (by Security System Integrator)
 1 Power supply (by Security System Integrator)
 Function: Door position status monitored through Access Control System.

Set 401
 All hardware by hatch manufacturer

Set 410
 1 Continuous geared hinge, Grade 1 edge mount - factory-finish to match storefront
 1 Narrow stile office function lockset, F04 x 1-3/4" backset
 1 Cylinder & core
 1 set Sound seals - Head & Jambs (by Frame Manufacturer)
 1 Threshold J32330 x 75 mm
 1 Automatic door bottom R3C346
 1 Stop (wall or floor as required)

Set 411
 1 Continuous geared hinge, Grade 1 edge mount - factory-finish to match storefront
 1 Narrow stile classroom function lockset, F05 x 1-3/4" backset
 1 Cylinder & core
 1 set Sound seals - Head & Jambs (by Frame Manufacturer)
 1 Threshold J32330 x 75 mm
 1 Automatic door bottom R3C346
 1 Wall/floor stop (as required)

Set 412
 1 Continuous geared hinge, Grade 1 edge mount - factory-finish to match storefront
 1 Narrow stile office function lockset, F04 x 1-3/4" backset
 1 Cylinder & core
 1 Stop (wall or floor as required)

Set 413
 1 Continuous geared hinge, Grade 1 edge mount - factory-finish to match storefront
 1 Narrow stile classroom function lockset, F05 x 1-3/4" backset
 1 Cylinder & core
 1 Concealed closer C75031 (with mechanical hold-open)
 1 Stop (wall or floor as required)

Set 414
 1 Continuous geared hinge, Grade 1 edge mount x EPT - factory-finish to match storefront
 1 Narrow stile electrified lockset, F07 x RX x FSE x 1-3/4" backset
 1 Cylinder & core
 1 Concealed closer C75031
 1 set Sound seals - Head & Jambs (by Frame Manufacturer)
 1 Threshold J32330 x 75 mm
 1 Automatic door bottom R3C346
 1 Power transfer pivot (equal to Securitron #CEPT-10)
 1 Concealed magnetic switch - Magnasphere # MSS-300C

1 Card reader (by Security System Integrator)
 1 Power supply (by Security System Integrator)
 1 Stop (wall or floor as required)
 Function: Card reader shunts magnetic switch and releases electrified lever trim. Turning inside lever shunts magnetic switch. Door position status monitored through Access Control System.

Set 415

1 Continuous geared hinge, Grade 1 edge mount x EPT - factory-finish to match storefront
 1 Narrow stile electrified lockset, F07 x RX x FSE x 1-3/4" backset
 1 Cylinder & core
 1 Concealed closer C75031
 1 Power transfer pivot (equal to Securitron #CEPT-10)
 1 Concealed magnetic switch - Magnasphere # MSS-300C
 1 Card reader (by Security System Integrator)
 1 Power supply (by Security System Integrator)
 1 Stop (wall or floor as required)
 Function: Card reader shunts magnetic switch and releases electrified lever trim. Turning inside lever shunts magnetic switch. Door position status monitored through Access Control System.

Set 416

1 Continuous geared hinge, Grade 1 edge mount - factory-finish to match storefront
 1 Narrow stile classroom function lockset, F05 x 1-3/4" backset
 1 Cylinder & core
 1 Concealed closer C75031 (with mechanical hold-open)
 1 set Sound seals - Head & Jambs (by Frame Manufacturer)
 1 Threshold J32330 x 75 mm
 1 Automatic door bottom R3C346
 1 Stop (wall or floor as required)

Set 420

2 Continuous geared hinges, Grade 1 edge mount - factory-finish to match storefront
 2 sets Push-pull bars (equal to Rockwood #RM7220-24" x RM7212 x 5HD/12HD-w/finished caps)
 2 Concealed closers C75031
 2 Stops (wall or floor as required)

Set 422

2 Continuous geared hinges, Grade 1 edge mount - factory-finish to match storefront
 2 sets Push-pull bars (equal to Rockwood #RM7220-24" x RM7212 x 5HD/12HD-w/finished caps)
 1 Power operator (surface-mount, pull-side, LH leaf)
 1 Operator actuator (flush-mount, pull-side, in wall adjacent to leaf with operator)
 1 Operator actuator (flush-mount, push-side, LH frame mullion)

1 Concealed closer C75031
 1 set Weather-stripping - Head, Jambs & Meeting Stile (by Door/Frame Manufacturer)
 2 Floor stops
 Function: Activating pull-side actuator auto-opens RHR leaf. Activating push-side actuator auto-opens LH leaf.

Set 431

1 Continuous geared hinge, Grade 1 edge mount - factory-finish to match storefront
 1 Classroom function exit device, Type 4-F08 x concealed fastening
 1 Cylinder & core
 1 Concealed closer C75031 (with mechanical hold-open)
 1 set Sound seals - Head & Jambs (by Frame Manufacturer)
 1 Threshold J32330 x 75 mm
 1 Automatic door bottom R3C346
 1 Wall/floor stop (as required)

Set 441

2 Continuous geared hinges, Grade 1 edge mount x EPT - factory-finish to match storefront
 1 Night latch function electrified exit device, Type 6-F03 x RX x less bottom rod x concealed fastening (with hex head dogging)
 1 Exit only electrified exit device, Type 6-F01 x RX x less bottom rod x concealed fastening
 1 Cylinder & core
 2 Pulls (equal to Rockwood #RM7220-24" x 12HD-w/finished caps)
 2 Concealed closers C75031
 1 set Weather-stripping - Head, Jambs & Meeting Stile (by Door/Frame Manufacturer)
 1 Threshold J36139
 2 Sill sweeps R3B416 (grey inserts) - pull side
 2 Power transfer pivots (equal to Securitron #CEPT-10)
 2 Concealed magnetic switches - Magnasphere # MSS-300C
 1 Power supply (by Security System Integrator)
 2 Floor stops (equal to Rockwood #466)

Function: Depressing either crash bar shunts magnetic switch. Door position status monitored through Access Control System.

Set 442

2 Continuous geared hinges, Grade 1 edge mount x EPT - factory-finish to match storefront
 1 Night latch function electrified exit device, Type 6-F03 (less dogging) x RX x ELR x less bottom rod x concealed fastening
 1 Exit only electrified exit device, Type 6-F01 (less dogging) x RX x ELR x less bottom rod x concealed fastening
 1 Cylinder & core
 2 Pulls (equal to Rockwood #RM7220-24" x 12HD-w/finished caps)
 1 Power operator (surface-mount, push-side, LH leaf)
 1 Operator actuator (flush-mount, pull-side, adjacent to card reader)
 1 Operator actuator (flush-mount, push-side, LH frame mullion)
 1 Access control-operator interface module (equal to BEA #Br3)
 1 Concealed closer C75031
 1 set Weather-stripping - Head, Jambs & Meeting Stile (by Door/Frame Manufacturer)
 1 Threshold J36139
 2 Sill sweeps R3B416 (grey inserts) - pull side

- 2 Power transfer pivots (equal to Securitron #CEPT-10)
- 2 Concealed magnetic switches - Magnasphere # MSS-300C
- 1 Card reader (by Security System Integrator)
- 1 Power supply (by Security System Integrator)
- 2 Floor stops (equal to Rockwood #446)

Function: Card reader shunts magnetic switches, retracts electric latches and enables pull-side actuator; activating actuator auto-opens RHR leaf. Depressing either crash bar shunts magnetic switch. Activating push-side actuator shunts magnetic switch, retracts electric latch and auto-opens LH leaf. Pull-side actuator should not function without proper signal from Access Control System. Door position status monitored through Access Control System.

Set 810

- Hinges A8112
- 1 Storeroom function lockset F07
- 1 Cylinder & core
- 1 Stop (wall or floor as required)

Set 811

- Hinges A8112
- 1 Storeroom function lockset F07
- 1 Cylinder & core
- 1 Surface closer C02011 / C02021
- 1 Stop (wall or floor as required)

Set 812

- Hinges A5112
- 1 Storeroom function lockset F07
- 1 Cylinder & core
- 1 Kick plate J102
- 1 Stop (wall or floor as required)

Set 814

- Hinges A8112
- 1 Electrified lockset F07 x RX x FSE
- 1 Cylinder & core
- 1 Surface closer C02011
- 1 Kick plate J102
- 1 set Sound seals R0E154 - Head & Jambs
- 1 Threshold J32330 x 75 mm
- 1 Automatic door bottom R3C346
- 1 Power transfer pivot (equal to Securitron # Securitron #CEPT-10)
- 1 Concealed magnetic switch - Magnasphere # MSS-300C
- 1 Card reader (by Security System Integrator)
- 1 Power supply (by Security System Integrator)
- 1 Stop (wall or floor as required)

Function: Card reader shunts magnetic switch and releases electrified lever trim. Turning inside lever shunts magnetic switch. Door position status monitored through Access Control System.

Set 815

- Hinges A8112
- 1 Electrified lockset F07 x RX x FSE
- 1 Cylinder & core
- 1 Surface closer C02011
- 1 Power transfer pivot (equal to Securitron # Securitron #CEPT-10)
- 1 Concealed magnetic switch - Magnasphere # MSS-300C
- 1 Card reader (by Security System Integrator)
- 1 Power supply (by Security System Integrator)

1 Stop (wall or floor as required)
 Function: Card reader shunts magnetic switch and releases electrified lever trim. Turning inside lever shunts magnetic switch. Door position status monitored through Access Control System.

Set 816

Hinges A8112
 1 Storeroom function lockset F07
 1 Cylinder & core
 1 Surface closer C02011
 1 set Sound seals R0E154 - Head & Jambs
 1 Threshold J32330 x 75 mm
 1 Automatic door bottom R3C346
 1 Stop (wall or floor as required)

Set 820

Hinges A8112
 1 Storeroom function lockset F07
 1 Cylinder & core
 2 Manual flush bolts L14081
 1 Dust strike L14021
 2 Kick plates J102
 2 Stops (wall or floor as required)
 Overlapping astragal by door manufacturer

Set 822

Hinges A5112
 1 Storeroom function lockset F07
 1 Cylinder & core
 1 set Self-latching flush bolts 5.3.3, Type 27
 1 Coordinator 5.1.3, Type 21A (field-paint to match frame)
 1 Dust strike L14021
 2 Surface closers C02011 / C02021
 2 Kick plates J102
 2 Stops (wall or floor as required)
 Overlapping astragal by door manufacturer

Set 823

Hinges A5112
 1 Storeroom function lockset F07
 1 Cylinder & core
 2 Manual flush bolts L14081
 1 Dust strike L14021
 2 Surface closers C02021 (with built-in stop & mechanical hold-open)
 2 Closer mounting brackets (equal to Zero #328SPB) - field-paint to match frame
 1 set Weather-stripping R3B165 - Head & Jambs
 1 Threshold J36139
 1 Overlapping astragal weather-strip (equal to Pemko #375CR) - install on pull side of active leaf
 2 Sill sweeps R3B416
 2 Concealed magnetic switches - Magnashpere #MSS-300C
 1 Power supply (by Security System Integrator)

Function: Door position status monitored through Access Control System.

Set 825

Hinges A8112 (provide two K81071 spring hinges at inactive leaf)

- 1 Electrified lockset F07 x RX x FSE
- 1 Cylinder & core
- 1 set Self-latching flush bolts 5.3.3, Type 27
- 1 Coordinator 5.1.3, Type 21A - field-paint to match frame
- 1 Dust strike L14021
- 1 Surface closer C02021
- 1 set Sound seals R0E154 - Head & Jambs
- 1 Threshold J32330 x 75 mm
- 1 Astragal sound seal R0E154 (apply to overlapping astragal)
- 2 Automatic door bottoms R3C336
- 1 Power transfer pivot (equal to Securitron # Securitron #CEPT-10)
- 2 Concealed magnetic switches - Magnasphere # MSS-300C
- 1 Card reader (by Security System Integrator)
- 1 Power supply (by Security System Integrator)
- 2 Stops (wall or floor as required)

Overlapping astragal by door manufacturer

Function: Card reader shunts magnetic switches and releases electrified lever trim. Turning inside lever shunts magnetic switch. Door position status monitored through Access Control System.

Set 826

Hinges A8112

- 1 Electrified lockset F07 x RX x FSE
- 1 Cylinder & core
- 1 set Self-latching flush bolts 5.3.3, Type 27
- 1 Coordinator 5.1.3, Type 21A - field-paint to match frame
- 1 Dust strike L14021
- 2 Surface closers C02021
- 1 set Sound seals R0E154 - Head & Jambs
- 1 Threshold J32330 x 75 mm
- 1 Astragal sound seal R0E154 (apply to overlapping astragal)
- 2 Automatic door bottoms R3C336
- 1 Power transfer pivot (equal to Securitron # Securitron #CEPT-10)
- 2 Concealed magnetic switches - Magnasphere # MSS-300C
- 1 Card reader (by Security System Integrator)
- 1 Power supply (by Security System Integrator)
- 2 Stops (wall or floor as required)

Overlapping astragal by door manufacturer

Function: Card reader shunts magnetic switches and releases electrified lever trim. Turning inside lever shunts magnetic switch. Door position status monitored through Access Control System.

Set 910

- 1 set Cam lift hinges x US32D (by Door Manufacturer)
- 1 Electrified SCIF lock Type IV x RX x FSE (equal to S&G #2890-543)
- 1 Strike mounting bracket (equal to Zero #770SPB) - field-paint to match frame
- 1 Cylinder & core
- 1 Surface closer C02021
- 1 Closer mounting bracket (equal to Zero #770SPB) - field-paint to match frame
- 1 set Acoustical seals - Head, Jambs & Sill (by Door Manufacturer)
- 1 Threshold (by Door Manufacturer)
- 1 Power transfer pivot (equal to Securitron #SEPT-10)
- 1 Surface-mounted magnetic switch (by Security System Integrator)

- 1 Card reader (by Security System Integrator)
- 1 Power supply (by Security System Integrator)
- 1 Stop (wall or floor as required)

Coordinate all hardware with STC Door Manufacturer

Function: Card reader shunts magnetic switch and releases electrified lever trim. Depressing crash bar shunts magnetic switch. Spin dial combination lock utilized for "lock & leave" conditions; depressing crash bar provides single-motion egress at all times. Door position status monitored through Access Control System.

Set 912

- 1 set Cam lift hinges x US32D (by Door Manufacturer)
- 1 Exit only SCIF lock, Type VI (equal to S&G #2890-563 with no exterior trim or spin dial)
- 1 Strike mounting bracket (equal to Zero #770SPB) - field-paint to match frame
- 1 Surface closer C02021
- 1 Closer mounting bracket (equal to Zero #770SPB) - field-paint to match frame
- 1 Alarmed exit sign x CSK (see Paragraph 2.3.5.5)
- 1 set Acoustical seals - Head, Jambs & Sill (by Door Manufacturer)
- 1 Threshold (by Door Manufacturer)
- 1 Sill sweep R3B416
- 1 Surface-mounted magnetic switch (by Security System Integrator)
- 1 Power supply (by Security System Integrator)
- 1 Floor stop

Coordinate all hardware with STC Door Manufacturer

Function: Opening door alerts Security Personnel. Door position status monitored through Access Control System.

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 81 00

GLAZING

05/19

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 SYSTEM DESCRIPTION
- 1.4 QUALITY CONTROL
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 INDOOR AIR QUALITY CERTIFICATION
- 1.7 ENVIRONMENTAL REQUIREMENTS
- 1.8 WARRANTY
 - 1.8.1 Warranty for Insulated Glass Units
 - 1.8.2 Monolithic Reflective Glass
 - 1.8.3 Monolithic Opacified Spandrel

PART 2 PRODUCTS

- 2.1 PRODUCT SUSTAINABILITY CRITERIA
- 2.2 GLASS
 - 2.2.1 Clear Glass
 - 2.2.2 Annealed Glass
 - 2.2.3 Laminated Glass
 - 2.2.4 Mirrors
 - 2.2.4.1 Glass Mirrors
 - 2.2.5 Tempered Glass
 - 2.2.6 Heat-Strengthened Glass
 - 2.2.7 Spandrel Glass
 - 2.2.7.1 Ceramic-Opacified Spandrel Glass
- 2.3 INSULATING GLASS UNITS
 - 2.3.1 Low Emissivity Coatings
- 2.4 SETTING AND SEALING MATERIALS
 - 2.4.1 Putty and Glazing Compound
 - 2.4.2 Glazing Compound
 - 2.4.3 Sealants
 - 2.4.3.1 Elastomeric Sealant
 - 2.4.3.2 Structural Sealant
 - 2.4.4 Glazing Tapes
 - 2.4.4.1 Back-Bedding Mastic Glazing Tapes
 - 2.4.4.2 Expanded Cellular Glazing Tapes
 - 2.4.5 Sealing Tapes
 - 2.4.6 Setting Blocks and Edge Blocks
 - 2.4.7 Glazing Gaskets
 - 2.4.7.1 Fixed Glazing Gaskets
 - 2.4.7.2 Wedge Glazing Gaskets
 - 2.4.7.3 Aluminum Framing Glazing Gaskets
 - 2.4.8 Accessories
- 2.5 MIRROR ACCESSORIES

- 2.5.1 Mastic
- 2.5.2 Mirror Frames
- 2.5.3 Mirror Clips

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 GLASS SETTING
 - 3.2.1 Sheet Glass
 - 3.2.2 Insulating Glass Units
 - 3.2.3 Installation of Laminated Glass
- 3.3 CLEANING
- 3.4 PROTECTION

-- End of Section Table of Contents --

SECTION 08 81 00

GLAZING

05/19

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 800 (2016) Voluntary Specifications and Test Methods for Sealants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (2015) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

ASTM INTERNATIONAL (ASTM)

ASTM C509 (2006; R 2021) Standard Specification 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	(2016) 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

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(2017) Procedure for Determining Fenestration Product U-Factors
NFRC 200	(2017) Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

U.S. 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 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

Insulating Glass

Glazing Accessories

Sealants

SD-04 Samples

Insulating Glass

Glazing Compound

Glazing Tape

Sealing Tapes

SD-07 Certificates

Insulating Glass

Indoor Air Quality for Mastics and Sealants; S

SD-08 Manufacturer's Instructions

Setting and Sealing Materials

Glass Setting

SD-11 Closeout Submittals

Warranty for Insulated Glass Units

Warranty for Monolithic Reflective Glass

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 glass unit as indicated.

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 INDOOR AIR QUALITY CERTIFICATION

Indoor Air Quality for Mastics and Sealants: Provide products applied within the building interior certified to meet indoor air quality requirements by California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for sealants and indoor air quality for mastics.

1.7 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the Contracting Officer are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy weather.

1.8 WARRANTY

1.8.1 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.

1.8.2 Monolithic Reflective Glass

Manufacturer must warrant the monolithic reflective glass to be free of peeling or deteriorating of coating for a period of 10 years after Date of Substantial Completion. Warranty must be signed by manufacturer.

1.8.3 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 PRODUCT SUSTAINABILITY CRITERIA

2.2 GLASS

ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.2.1 Clear Glass

For interior glazing (i.e., pass and observation windows), minimum 3/8 inch thick glass should be used.

Type I, Class 1 (clear), Quality q4 (A). Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not over 45 square feet.

2.2.2 Annealed Glass

Annealed glass must be Type I transparent flat type, Class 1 - clear, Quality q3 - glazing select, 60 percent light transmittance, 0.4 percent shading coefficient, conforming to ASTM C1036.

2.2.3 Laminated Glass

ASTM C1172, Laminated glass fabricated from two nominal 1/8 inch pieces of Type I, Class 1, Quality Q3, flat annealed; clear glass conforming to ASTM C1172. Laminated glass fabricated from two nominal 1/8 inch pieces of Type I, Kind heat strengthened, Condition A or B, 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 thick, clear polyvinyl butyral laminate, conforming to requirements of 16 CFR 1201 and ASTM C1172. The total thickness of nominally 1/4 inches. Color to be clear.

2.2.4 Mirrors

2.2.4.1 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.

2.2.5 Tempered Glass

ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent) Quality q3, inch thick, 60 percent light transmittance, 0.4 percent shading coefficient conforming to ASTM C1048 and GANA Standards Manual. Color must be clear. Provide as indicated and wherever safety glazing material is indicated or specified.

2.2.6 Heat-Strengthened Glass

ASTM C1048, Kind HS (heat strengthened), Condition A (uncoated), Type I, Class 1 (clear) Quality q3, Thickness as indicated.

2.2.7 Spandrel Glass

2.2.7.1 Ceramic-Opacified Spandrel Glass

Ceramic-opacified spandrel glass must be Kind HS heat-strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 2 surface, Quality q3 - glazing select, 1/8 inch thick, and 1/4 inch (2 x 1/4") as part of laminated glass used in IGU conforming to ASTM C1048. Glass performance must be R-Value/Winter Nighttime 0.42, shading coefficient 0.4. Color must be as indicated.

2.3 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.

Insulated glass units must have a Solar Heat Gain Coefficient (SHGC) maximum of 0.4 determined according to NFRC 200 and a U-factor maximum of 0.42 Btu per square foot by hr by degree F in accordance with NFRC 100.

See section 08 44 00 CURTAIN WALL AND GLAZED ASSEMBLIES for energy performance requirements for glazed systems (glazing and frames). 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.

IGU-1 Exterior Clear:

¼" Heat-strengthened Clear glass, Low E coating on #2 Surface
 ½" Argon Filled Air Space
 ¼" (2x 1/8") Heat-strengthened laminated clear glass

IGU-2 Exterior Spandrel:

¼" Heat-strengthened Clear glass, Low E coating on #2 Surface
 ½" Argon Filled Air Space ¼" heat-strengthened opaque glass
 Ceramic Frit on #4 Surface

IGU-3 Exterior Clear Safety:

¼" Tempered clear glass, Low E coating on #2 Surface
½" Argon Filled Air Space
¼" (2x 1/8") heat-strengthened laminated clear glass

2.3.1 Low Emissivity Coatings

Interior and exterior glass panes for Low-E insulating units must be Type I heat-strengthened flat glass, Class 1-clear with anti-reflective low-emissivity coating or heat-strengthened or fully tempered glass complying with ASTM C1048, Condition C on No. 2 surface (inside surface of exterior pane), Quality q3 - glazing select, conforming to ASTM C1036. Glass performance must be U value maximum of 0.42 Btu/hr-ft²-F, Solar Heat Gain Coefficient (SHGC) maximum of 0.4. Color must be clear.

2.4 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.

2.4.1 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.

2.4.2 Glazing Compound

Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.4.3 Sealants

Provide elastomeric and structural sealants.

2.4.3.1 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.

2.4.3.2 Structural Sealant

ASTM C1184, Type S.

2.4.4 Glazing Tapes

2.4.4.1 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.

2.4.4.2 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.

2.4.5 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.

2.4.6 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.

2.4.7 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.

2.4.7.1 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.

2.4.7.2 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.

2.4.7.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing must be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.4.8 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.

2.5 MIRROR ACCESSORIES

2.5.1 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. Comply with low-emitting requirements in Section 01 33 29 SUSTAINABILITY REPORTING.

2.5.2 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.

2.5.3 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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 08 - OPENINGS

SECTION 08 91 00

METAL WALL AND DOOR LOUVERS

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND PROTECTION
- 1.4 DETAIL DRAWINGS
- 1.5 COLOR SAMPLES

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Galvanized Steel Sheet
 - 2.1.2 Aluminum Sheet
 - 2.1.3 Extruded Aluminum
- 2.2 METAL WALL LOUVERS
 - 2.2.1 Extruded Aluminum Louvers
 - 2.2.2 Formed Metal Louvers
 - 2.2.3 Mullions and Mullion Covers
 - 2.2.4 Screens and Frames
- 2.3 DOOR LOUVERS
 - 2.3.1 Extruded Aluminum Door Louvers
 - 2.3.2 Formed Metal Door Louvers
 - 2.3.3 Screens and Frames
- 2.4 FASTENERS AND ACCESSORIES
- 2.5 FINISHES
 - 2.5.1 Aluminum
 - 2.5.1.1 Organic Coating
 - 2.5.2 Steel

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Wall Louvers
 - 3.1.2 Door Louvers
 - 3.1.3 Screens and Frames
- 3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS
 - 3.2.1 Copper or Copper-Bearing Alloys
 - 3.2.2 Aluminum
 - 3.2.3 Metal
 - 3.2.4 Wood

-- End of Section Table of Contents --

SECTION 08 91 00

METAL WALL AND DOOR 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 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 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 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

Wall Louvers

SD-03 Product Data

Metal Wall Louvers

Door Louvers

SD-04 Samples

Wall Louver Samples; G

Door Louver Samples; G

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 and door 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.

2.2 METAL WALL LOUVERS

Weather and 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 Formed Metal Louvers

Formed of zinc-coated steel sheet not thinner than 16 U.S. gage, or aluminum sheet not less than 0.08 inch thick.

2.2.3 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.

2.2.4 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. For steel louvers, provide 1/2 inch square mesh, 12 or 16 gage zinc-coated steel; 1/2 inch square mesh, 16 gage copper; or 1/4 inch square mesh, 16 gage zinc-coated steel or copper bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 DOOR LOUVERS

Louvers for exterior doors must be weather resistant type.

2.3.1 Extruded Aluminum Door Louvers

Fabricate of 6063-T5 or -T52 aluminum alloy with a wall thickness of not less than 0.050 inch thick. Frames and trim must be clamp-in "L" type.

2.3.2 Formed Metal Door Louvers

Fabricate of 20 U.S. gage steel sheet. Trim must be beveled "Z" molding both sides.

2.3.3 Screens and Frames

For exterior doors, provide aluminum insect screens, 18 by 16 or 18 by 14 mesh. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.4 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.

2.5 FINISHES

2.5.1 Aluminum

Exposed aluminum surfaces must be factory finished with an organic coating.

Color must be as indicated. Louvers must have the same finish.

2.5.1.1 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.

2.5.2 Steel

Surfaces specified must have a zinc coating, a phosphate treatment, and a shop prime coat of rust-inhibitive paint. The galvanized coating must conform to ASTM A653/A653M, coating designation Z275 (G90). The weight of zinc coatings must be as designated in Table I of ASTM A123/A123M for the thickness of base metal to be coated. The prime coat must be a type especially developed for materials treated by phosphates and adapted to application by dipping or spraying. Repair damaged zinc-coated surfaces by the materials and methods conforming to ASTM A780/A780M and spot prime. At the option of the Contractor, a two-part system including bonderizing, baked-on epoxy primer, and baked-on enamel top coat may be applied before forming, in lieu of prime coat specified.

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 Door Louvers

Install louvers in wood doors by using metal "Z" or "L" moldings. Fasten moldings to door with screws.

3.1.3 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.3 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.4 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD

02/10, CHG 2: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Materials for Attachment of Gypsum Wallboard
 - 2.1.1.1 Suspended and Furred Ceiling Systems
 - 2.1.1.2 Non-load Bearing Wall Framing and Furring
 - 2.1.1.3 Deflection Track (in lieu of nested runners)
 - 2.1.1.4 Furring Structural Steel Columns

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Systems for Attachment of Gypsum Wallboard
 - 3.1.1.1 Suspended and Furred Ceiling Systems
 - 3.1.1.2 Non-load Bearing Wall Framing and Furring
 - 3.1.1.3 Furring Structural Steel Columns
- 3.2 ERECTION TOLERANCES

-- End of Section Table of Contents --

SECTION 09 22 00

SUPPORTS FOR PLASTER AND GYPSUM BOARD
02/10, CHG 2: 08/18

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A463/A463M	(2015; R 2020; E 2020) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C645	(2014; E 2015) Nonstructural Steel Framing Members
ASTM C754	(2020) Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products

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 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

Metal Support Systems

Recycled Content for Metal Support Systems; S

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 metal support systems containing a minimum of 25 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, thickness as indicated on the drawings.

2.1.1.3 Deflection Track (in lieu of nested runners)

Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above in thickness indicated for studs and in width to accommodate depth of studs. Deflection tracks shall accommodate a minimum 1 inch deflection in all locations. Subject to compliance with requirements, provide one of the following:

- a. The Steel Network, Inc.; VertiClip SLD Series or Vertitrack VTD Series, Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT) Metal-Lite, Inc.; Slotted Track.

2.1.1.4 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.

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. Provide deflection tracks at all full height gypsum wallboard. Deflection tracks shall maintain the required fire rating of the wall system.

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) of the fire resistance rating indicated.

3.2 ERECTION TOLERANCES

Provide framing members which will be covered by finish materials such as wallboard, plaster, or ceramic tile set in a mortar setting bed, within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/4 inch in 8 feet from a straight line;
- c. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/4 inch in 8 feet from a true plane.

Provide framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive within the following limits:

- a. Layout of walls and partitions: 1/4 inch from intended position;
- b. Plates and runners: 1/8 inch in 8 feet from a straight line;
- c. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and
- d. Face of framing members: 1/8 inch in 8 feet from a true plane.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 29 00

GYPSUM BOARD

08/16, CHG 4: 02/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality Certifications
 - 1.3.1.1 Ceiling and Wall Systems
 - 1.3.1.2 Adhesives and Sealants
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - 1.4.1 Delivery
 - 1.4.2 Storage
 - 1.4.3 Handling
- 1.5 QUALIFICATIONS
- 1.6 SCHEDULING
- 1.7 ENVIRONMENTAL REQUIREMENTS
- 1.8 FIRE RESISTIVE CONSTRUCTION

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Gypsum Board
 - 2.1.1.1 Regular
 - 2.1.1.2 Type X (Special Fire-Resistant)
 - 2.1.1.3 Mold Resistant / Anti-Microbial Gypsum
 - 2.1.2 Regular Water-Resistant Gypsum Backing Board
 - 2.1.2.1 Regular
 - 2.1.2.2 Type X (Special Fire-Resistant)
 - 2.1.3 Glass Mat Water-Resistant Gypsum Tile Backing Board
 - 2.1.3.1 Regular
 - 2.1.3.2 Type X (Special Fire-Resistant)
 - 2.1.4 Acoustical Enhanced Gypsum Board
 - 2.1.5 Joint Treatment Materials
 - 2.1.5.1 Embedding Compound
 - 2.1.5.2 Finishing or Topping Compound
 - 2.1.5.3 All-Purpose Compound
 - 2.1.5.4 Setting or Hardening Type Compound
 - 2.1.5.5 Joint Tape
 - 2.1.6 Fasteners
 - 2.1.6.1 Screws
 - 2.1.7 Adhesives
 - 2.1.7.1 Adhesive for Fastening Gypsum Board to Metal Framing
 - 2.1.7.2 Adhesive for Fastening Gypsum Board to Wood Framing
 - 2.1.7.3 Adhesive for Laminating
 - 2.1.8 Shaftwall Liner Panel
 - 2.1.9 Accessories
 - 2.1.10 Asphalt Impregnated Building Felt

2.1.11 Water

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

3.1.2 Gypsum Board and Framing

3.1.3 Building Construction Materials

3.2 APPLICATION OF GYPSUM BOARD

3.2.1 Application of Gypsum Board to Steel Framing and Furring

3.2.2 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

3.2.3 Control Joints

3.3 FINISHING OF GYPSUM BOARD

3.3.1 Uniform Surface

3.4 SEALING

3.5 FIRE-RESISTANT ASSEMBLIES

3.6 PATCHING

3.7 SHAFTWALL FRAMING

-- End of Section Table of Contents --

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.

ASTM INTERNATIONAL (ASTM)

ASTM C475/C475M	(2017) 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 C1178/C1178M	(2013) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C1396/C1396M	(2017) Standard Specification for Gypsum Board
ASTM C1629/C1629M	(2018a) Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels
ASTM D226/D226M	(2017) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D3273	(2016) Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber

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

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

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

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

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 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

Glass Mat Water-Resistant Gypsum Tile Backing Board

Water-Resistant Gypsum Backing Board

Accessories

Submit for each type of gypsum board.

Gypsum Board

Recycled Content for Gypsum Board; S

Recycled Content for Paper Facing and Gypsum Cores; S

VOC Content of Joint Compound; S

SD-07 Certificates

Asbestos Free Materials; G

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; S

Indoor Air Quality for Adhesives and Sealants; S

Indoor Air Quality for Joint Compound; S

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 gypsum board and joint compound certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold. Submit product data for indoor air quality for gypsum board and indoor air quality for joint compound.

1.3.1.2 Adhesives and Sealants

Provide adhesives and sealants applied within the building interior certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for adhesives and sealants.

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 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 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

The gypsum wallboard must be taped, finished and primed before the installation of the highly-emitting materials. The gypsum wallboard must be installed after the installation and ventilation period of the highly-emitting materials.

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, 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 20 percent post-consumer recycled content, or a minimum of 40 percent pre-consumer 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 pre-consumer 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 edges.

2.1.1.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.1.3 Mold Resistant / Anti-Microbial Gypsum

ASTM D3273. 48 inch wide, 5/8 inch thick, tapered edges.

2.1.2 Regular Water-Resistant Gypsum Backing Board

ASTM C1396/C1396M

2.1.2.1 Regular

48 inch wide, 5/8 inch thick, tapered edges.

2.1.1.2.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, tapered edges.

2.1.1.3 Glass Mat Water-Resistant Gypsum Tile Backing Board

ASTM C1178/C1178M

2.1.1.3.1 Regular

48 inch wide, 5/8 inch thick, square edges.

2.1.1.3.2 Type X (Special Fire-Resistant)

48 inch wide, 5/8 inch thick, square edges.

2.1.1.4 Acoustical Enhanced Gypsum Board

Performance Criteria - Wall Assembly STC: 50 UNO

Panel Physical Characteristics

a. Core

1. Inner layer: Viscoelastic damping polymer

2. Outer layers: Enhanced, high density mold-resistance gypsum core

b. Overall thickness: 5/8", Type X

c. Edges: Tapered

d. Mold Resistance:

1. 10 when tested in accordance with ASTM D3273

2. 0 when tested in accordance with ASTM G21

e. Surface Abrasion Resistance: Classification Level 3 in accordance with ASTM C1629/C1629M

f. Indentation Resistance: Classification Level 1 in accordance with ASTM C1629/C1629M

g. Soft Body Impact Resistance: Classification Level 2 in accordance with ASTM C1629/C1629M

h. Hard Body Impact Resistance: Level 1 in accordance with ASTM C

i. Environmental Requirements: Provide products that comply with testing and product requirements for low emitting materials.

2.1.1.5 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. Use all purpose joint and texturing compound containing inert fillers and natural binders, including lime compound. Pre-mixed compounds must be free of antifreeze, vinyl adhesives, preservatives, biocides and

other slow releasing compounds.

2.1.5.1 Embedding Compound

Specifically formulated and manufactured for use in embedding tape at gypsum board joints and compatible with tape, substrate and fasteners.

2.1.5.2 Finishing or Topping Compound

Specifically formulated and manufactured for use as a finishing compound.

2.1.5.3 All-Purpose Compound

Specifically formulated and manufactured to serve as both a taping and a finishing compound and compatible with tape, substrate and fasteners.

2.1.5.4 Setting or Hardening Type Compound

Specifically formulated and manufactured for use with fiber glass mesh tape.

2.1.5.5 Joint Tape

Use cross-laminated, tapered edge, reinforced paper, or fiber glass mesh tape recommended by the manufacturer.

2.1.6 Fasteners

2.1.6.1 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.

2.1.7 Adhesives

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol 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 GS-36. Provide certification or validation of indoor air quality for adhesives and sealants applied on the interior of the building (inside of the weatherproofing system).

2.1.7.1 Adhesive for Fastening Gypsum Board to Metal Framing

Not permitted.

2.1.7.2 Adhesive for Fastening Gypsum Board to Wood Framing

Not permitted.

2.1.7.3 Adhesive for Laminating

Not permitted.

2.1.8 Shaftwall Liner Panel

ASTM C1396/C1396M. Conform to the UL Fire Resistance for the Design Numbers(s) indicated for shaftwall liner panels. Manufacture liner panel for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 1 inch thick, by 24inch wide.

2.1.9 Accessories

ASTM C1047. Fabricate from corrosion protected steel or plastic designed for intended use. Accessories manufactured with paper flanges are not acceptable. Flanges must be free of dirt, grease, and other materials that may adversely affect bond of joint treatment. Provide prefinished or job decorated materials.

2.1.10 Asphalt Impregnated Building Felt

Provide a 15 lb asphalt moisture barrier over glass mat covered or reinforced gypsum sheathing. Conforming to ASTM D226/D226M Type 1 (No. 15) for asphalt impregnated building felt.

2.1.11 Water

Provide clean, fresh, and potable water.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Framing and Furring

Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board and cementitious backer units. Verify that all blocking, headers and supports are in place to support plumbing fixtures and to receive soap dishes, grab bars, towel racks, and similar items. Do not proceed with work until framing and furring are acceptable for application of gypsum board and cementitious backer units.

3.1.2 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. Provide type of gypsum board for use in each system specified herein as indicated.

3.2.1 Application of Gypsum Board to Steel Framing and Furring

Apply in accordance with ASTM C840, System VIII or GA 216.

3.2.2 Gypsum Board for Wall Tile or Tile Base Applied with Adhesive

In dry areas (areas other than tubs, shower enclosures, saunas, steam rooms, gang shower rooms), apply glass mat water-resistant gypsum tile backing board or water-resistant gypsum backing board in accordance with ASTM C840, System X or GA 216.

3.2.3 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.

3.3 FINISHING OF GYPSUM BOARD

Tape and finish gypsum board in accordance with ASTM C840, GA 214 and GA 216. Finish plenum areas above ceilings to Level 1 in accordance with GA 214. Finish water resistant gypsum backing board, ASTM C1396/C1396M, to receive ceramic tile to Level 2 in accordance with GA 214. Finish walls and ceilings to receive a heavy-grade wall covering or heavy textured finish before painting to Level 3 in accordance with GA 214. Finish walls and ceilings without critical lighting to receive flat paints, light textures, or wall coverings to Level 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.

3.3.1 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.

3.4 SEALING

Seal openings around pipes, fixtures, and other items projecting through gypsum board and cementitious backer units as specified in Section 07 92 00 JOINT SEALANTS. Apply material with exposed surface flush with gypsum board or cementitious backer units.

3.5 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.

3.6 PATCHING

Patch surface defects in gypsum board to a smooth, uniform appearance, ready to receive finishes.

3.7 SHAFTWALL FRAMING

Install the shaftwall system in accordance with the system manufacturer's published instructions. Coordinate bucks, anchors, blocking and other items placed in or behind shaftwall framing with electrical and mechanical work. Patch or replace fireproofing materials which are damaged or removed during shaftwall construction.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 30 10

CERAMIC, QUARRY, AND GLASS TILING

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality Certifications
 - 1.3.1.1 Wall and Flooring Systems
 - 1.3.1.2 Adhesives and Sealants
 - 1.3.1.3 Coatings
 - 1.3.2 Water Absorption Rates Certification
- 1.4 QUALITY ASSURANCE
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 ENVIRONMENTAL REQUIREMENTS
- 1.7 WARRANTY
- 1.8 EXTRA MATERIALS

PART 2 PRODUCTS

- 2.1 TILE
 - 2.1.1 Porcelain Tile PFT-1, PWT-1
 - 2.1.2 Glazed Ceramic Wall Tile CWT-1, CWT-2
- 2.2 SETTING-BED
 - 2.2.1 Aggregate for Concrete Fill
 - 2.2.2 Portland Cement
 - 2.2.3 Sand
 - 2.2.4 Hydrated Lime
 - 2.2.5 Metal Lath
- 2.3 WATER
- 2.4 MORTAR, GROUT, AND ADHESIVE
 - 2.4.1 Dry-Set Portland Cement Mortar
 - 2.4.2 Furan Mortar
 - 2.4.3 Latex-Portland Cement Mortar
 - 2.4.4 Ceramic Tile Grout
 - 2.4.5 Organic Adhesive
 - 2.4.6 Epoxy Resin Grout
 - 2.4.7 Furan Resin Grout
 - 2.4.8 Urethane Grout
 - 2.4.9 Sealants
- 2.5 SUBSTRATES
 - 2.5.1 Cementitious Backer Units
 - 2.5.2 Glass-Mat Gypsum Water-Resistant Backing Board
- 2.6 MISCELLANEOUS TRIMS
 - 2.6.1 Transition Strips
- 2.7 WATERPROOF MEMBRANE
 - 2.7.1 General
 - 2.7.2 Chlorinated-Polyethylene Shower Waterproof Membrane

- 2.8 CRACK ISOLATION MEMBRANE
 - 2.8.1 General
 - 2.8.2 Chlorinated-Polyethylene Crack Isolation Membrane
- 2.9 COLOR, TEXTURE, AND PATTERN

PART 3 EXECUTION

- 3.1 PREPARATORY WORK AND WORKMANSHIP
- 3.2 GENERAL INSTALLATION REQUIREMENTS
- 3.3 INSTALLATION OF SUBSTRATES
 - 3.3.1 Cementitious Backer Units and Glass-Mat Water-Resistant Backing Board
- 3.4 INSTALLATION OF WALL TILE
 - 3.4.1 Installation of Gauged Porcelain Tile
 - 3.4.2 Workable or Cured Mortar Bed
 - 3.4.3 Dry-Set Mortar and Latex-Portland Cement Mortar
 - 3.4.4 Organic Adhesive
 - 3.4.5 Furan Mortar and Grout
 - 3.4.6 Ceramic Tile Grout
 - 3.4.7 Epoxy Resin Grout
 - 3.4.8 Urethane Grout
- 3.5 INSTALLATION OF FLOOR TILE
 - 3.5.1 Installation of Gauged Porcelain Tile
 - 3.5.2 Workable or Cured Mortar Bed
 - 3.5.3 Dry-Set and Latex-Portland Cement
 - 3.5.4 Ceramic Tile Grout
 - 3.5.5 Waterproof and Crack Isolation Membranes
 - 3.5.6 Concrete Fill
- 3.6 INSTALLATION OF MISCELLANEOUS TRIMS
 - 3.6.1 Transition Strips
 - 3.6.2 Metal Trims
- 3.7 EXPANSION JOINTS
 - 3.7.1 Walls
 - 3.7.2 Floors
- 3.8 CLEANING AND PROTECTING

-- End of Section Table of Contents --

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 A108/A118/A136.1 | (2019) American National Standard Specifications for the Installation of Ceramic Tile |
| 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 | (2020) 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 C241/C241M | (2020) Standard Specification for Abrasion Resistance of Stone Subjected to Foot Traffic |
| 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
ASTM C1026	(2013; R 2018) Standard Test Method for Measuring the Resistance of Ceramic and Glass Tile to Freeze-Thaw Cycling
ASTM C1027	(2009; R 2017) Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C1178/C1178M	(2013) Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel

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
-------	-------------------------------------

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	(2016) Dimension Stone Design Manual
-------------------	--------------------------------------

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

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 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

Detail Drawings; G, AE

SD-03 Product Data

Porcelain Tile; G

Recycled Content for Porcelain Tile; S

Glazed Ceramic Wall Tile; G

Recycled Content for Glazed Ceramic Wall Tile; S

Transition Strips; G

Setting-Bed; G

Mortar, Grout, and Adhesive; G

Cementitious Backer Units; G

Glass-Mat Gypsum Water-Resistant Backing Board; G

Waterproof Membrane; G

Crack Isolation Membrane; G

SD-04 Samples

Tile; G

Accessories; G

Transition Strips; G

Grout; G

SD-07 Certificates

Indoor Air Quality for Adhesives; S

Indoor Air Quality for Sealants; S

Water Absorption Rates

Indoor Air Quality for Mortar and Grout; S

Indoor Air Quality for Cementitious Backer Units; S

Indoor Air Quality for Glass-Mat Gypsum Board; S

Indoor Air Quality for Primer and Sealer; S

Indoor Air Quality for Waterproofing Membrane and Crack Isolation Membrane; S

SD-08 Manufacturer's Instructions

Manufacturer's Approved Cleaning Instructions

SD-10 Operation and Maintenance Data

Porcelain Tile, Data Package 1; G

Glazed Ceramic Wall Tile, Data Package 1; G

Transition Strips, Data Package 1; G

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.3.1.1 Wall and Flooring Systems

Provide glass-mat gypsum board and cementitious backer units certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold. Submit product data for indoor air quality for glass-mat gypsum board and indoor air quality for cementitious backer units.

1.3.1.2 Adhesives and Sealants

Provide adhesives and sealants applied within the building interior certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for adhesives and sealants and indoor air quality for mortar and grout.

1.3.1.3 Coatings

Provide coatings applied within the building interior certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of Green Seal GS-11, California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings, or SCAQMD Rule 1113. Submit product data for indoor air quality for primer and sealer and indoor air quality for waterproofing membrane and crack isolation membrane.

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 Tile (Impervious): Provide water absorption (wa) of 0.5

percent or less.

- b. Mosaic Tile (Vitreous): Provide water absorption (wa) of more than 0.5 percent, but not more than 3.0 percent.

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 tiles 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 exterior building tile for cold climate projects that is approved by the manufacturer for exterior use when tested in accordance with ASTM C1026. Provide floor tiles with a minimum wet dynamic coefficient of friction (DCOF) value of 0.42 when tested in accordance with ANSI A137.1 requirements. Provide glazed floor tile with a Class IV-Commercial classification as rated by the manufacturer when tested in accordance with ASTM C1027 for visible abrasion resistance as related to foot traffic. For materials like tile, accessories, and transition strips

submit samples of sufficient size to show color range, pattern, type and joints.

Submit manufacturers' descriptive product data for each type of ceramic, quarry and glass tiling indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each type of ceramic, quarry and glass tiling indicated in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Porcelain Tile PFT-1, PWT-1

Provide through body (surface color and pattern go all the way through the tile body), and cove base and trim pieces. 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) of 12 by 24 inch and 5/16 inch thick.

Provide porcelain tiling materials that contain a minimum of 10 percent recycled content. Provide data identifying percentage of recycled content for porcelain tile.

2.1.2 Glazed Ceramic Wall Tile CWT-1, CWT-2

Provide glazed ceramic wall tile that has square edges and trim with lead-free finish. Provide nominal tile size(s) as indicated on drawings.

Provide glazed ceramic wall tile materials that contain a minimum of 3 percent recycled content. Provide data identifying percentage of recycled content for glazed ceramic wall tile.

2.2 SETTING-BED

Submit manufacturer's catalog data. Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C33/C33M for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C150/C150M for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C144 for sand.

2.2.4 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. Provide aerosol adhesives used on the interior of the building meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of GS-36. For products located on the interior of the building (inside of the weatherproofing system, provide certification or validation of indoor air quality for adhesives. Provide bond coat, mortar, and grout supplied from the same manufacturer.

2.4.1 Dry-Set Portland Cement Mortar

TCNA Hdbk.

2.4.2 Furan Mortar

TCNA Hdbk.

2.4.3 Latex-Portland Cement Mortar

TCNA Hdbk.

2.4.4 Ceramic Tile Grout

TCNA Hdbk; petroleum-free and plastic-free sand-portland cement grout and standard unsanded cement grout (dry-set grout).

2.4.5 Organic Adhesive

TCNA Hdbk, Type I. Water-resistant. Comply with ANSI A108/A118/A136.1.

2.4.6 Epoxy Resin Grout

TCNA Hdbk. Water cleanable epoxy conforming to ANSI A108/A118/A136.1; provide manufacturer proportioned and packaged kit having hardener, resin and colored filler and horizontal and vertical grade products as applicable. Provide antimicrobial additive designed for prevention of mold and mildew.

2.4.7 Furan Resin Grout

TCNA Hdbk; chemical resistant furan conforming to ANSI A108/A118/A136.1; and consist of an intimate mixture of furfuryl-alcohol resin with carbon filler and catalyst.

2.4.8 Urethane Grout

TCNA Hdbk; premixed, urethane, water-based grout with color consistency and antimicrobial protection; no color fading, streaking or shading, chemical and stain resistant; and UV stable.

2.4.9 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 units and glass-mat water-resistant backing board.

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.

2.5.2 Glass-Mat Gypsum Water-Resistant Backing Board

Provide glass-mat water-resistant backing board, for use as tile substrate as indicated, in accordance with ASTM C1178/C1178M. Provide 5/8 inch thick glass-mat water-resistant backing board.

2.6 MISCELLANEOUS TRIMS

2.6.1 Transition Strips

Provide types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified marble transitions appropriate for conditions. Categorize marble Group A as classified by MIA Design Manual. Provide a fine sand-rubbed finish marble, gray or beige in color. Provide minimum 12.0 marble abrasion when tested in accordance with ASTM C241/C241M. Solid surfacing material transitions appropriate for conditions. Refer to Section 06 61 16 SOLID SURFACING FABRICATIONS. Provide transition strips that comply with 36 CFR 1191 requirements.

2.7 WATERPROOF MEMBRANE

2.7.1 General

Manufacturer's standard product that complies with ANSI A108/A118/A136.1 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.7.2 Chlorinated-Polyethylene Shower Waterproof Membrane

Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.040 inch nominal thickness.

2.8 CRACK ISOLATION MEMBRANE

2.8.1 General

Manufacturer's standard product that complies with ANSI A108/A118/A136.1 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

2.8.2 Chlorinated-Polyethylene Crack Isolation Membrane

Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric; 0.030 inch nominal thickness.

2.9 COLOR, TEXTURE, AND PATTERN

Provide color, pattern and texture as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers..

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCNA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	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 SUBSTRATES

3.3.1 Cementitious Backer Units and Glass-Mat Water-Resistant Backing Board

Install as specified in Section 09 29 00 GYPSUM BOARD.in accordance with manufacturer's written instructions.

3.4 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCNA Hdbk, method 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.

3.4.1 Installation of Gauged Porcelain Tile

Install gauged porcelain tile in accordance with TCNA Hdbk method and ANSI A137.3/A108.19 for thin-bed method bonded with modified dry-set cement mortar over improved modified dry-set cement mortar.

3.4.2 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 method for workable mortar bed, materials, and installation of tile. Conform to TCNA Hdbk method for cured mortar bed and materials.

3.4.3 Dry-Set Mortar and Latex-Portland Cement Mortar

Use dry-set or latex-portland cement to install tile in accordance with TCNA Hdbk method . Use latex-portland cement when installing porcelain ceramic tile.

3.4.4 Organic Adhesive

Comply with the requirements of TCNA Hdbk method for organic adhesive installation of ceramic tile.

3.4.5 Furan Mortar and Grout

Comply with the requirements of TCNA Hdbk method for furan mortar and grout installation.

3.4.6 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCNA Hdbk method. Provide and apply manufacturer's standard product for sealing grout joints in accordance with manufacturer's recommendations.

3.4.7 Epoxy Resin Grout

Prepare and install epoxy resin grout in accordance with TCNA Hdbk method.

3.4.8 Urethane Grout

Prepare and install urethane grout in accordance with TCNA Hdbk method.

3.5 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCNA Hdbk method specified herein and with grout joints as recommended by the manufacturer for the type of tile. Install shower receptors in accordance with TCNA Hdbk method B414.

3.5.1 Installation of Gauged Porcelain Tile

Install gauged porcelain tile in accordance with TCNA Hdbk method and ANSI A137.3/A108.19 for thin-bed method bonded with modified dry-set cement mortar over improved modified dry-set cement mortar.

3.5.2 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 method for workable mortar bed materials and installation. Conform to TCNA Hdbk method for cured mortar bed materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniformed width.

3.5.3 Dry-Set and Latex-Portland Cement

Use dry-set or latex-portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCNA Hdbk method. Use latex-portland cement when installing porcelain ceramic tile.

3.5.4 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCNA Hdbk method. Provide and apply manufacturer's standard product for sealing grout joints in accordance with manufacturer's recommendations.

3.5.5 Waterproof and Crack Isolation Membranes

Install as indicated in accordance with manufacturer's written instructions.

3.5.6 Concrete Fill

Provide a 3500 psi concrete fill mix to dry as consistency as practicable. Spread, tamp, and screed concrete fill to a true plane, and pitch to drains or levels as shown. Thoroughly damp concrete fill before applying setting-bed material. Reinforce concrete fill with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped a minimum 2 inch. Tie laps together with 18 gauge wire every 10 inch along the finished edges and every 6 inch along the cut ends and edges. Provide reinforcement with support and secure in the centers of concrete fills. Provide a continuous mesh; except where expansion joints occur, cut mesh and discontinue across such joints. Provide reinforced concrete fill under the setting-bed where the distance

between the under-floor surface and the finished tiles floor surface is a minimum of 2 inches, and of the same thickness that the mortar setting-bed over the concrete fill with the thickness required in the specified TCNA Hdbk method.

3.6 INSTALLATION OF MISCELLANEOUS TRIMS

3.6.1 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.

3.6.2 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.

3.7 EXPANSION JOINTS

Form and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.7.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.7.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs in accordance with TCNA Hdbk method EJ171 type to suit conditions. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 20 to 25 feet each way in large interior floor areas. Extend expansion joints through setting-beds and fill.

3.8 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 51 00

ACOUSTICAL CEILINGS

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality Certifications
 - 1.3.1.1 Ceiling Tiles
 - 1.3.1.2 Adhesives and Sealants
- 1.4 DELIVERY, STORAGE. AND HANDLING
- 1.5 ENVIRONMENTAL REQUIREMENTS
- 1.6 SCHEDULING
- 1.7 WARRANTY
- 1.8 EXTRA MATERIALS

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Fire Resistive Ceilings
 - 2.1.2 Acoustical Performance
 - 2.1.2.1 Ceiling Sound Transmission
 - 2.1.2.2 Ceiling Sound Absorption
 - 2.1.3 Light Reflectance
- 2.2 ACOUSTICAL UNITS
 - 2.2.1 Units for Exposed-Grid System ACP-1
 - 2.2.1.1 Type
 - 2.2.1.2 Flame Spread
 - 2.2.1.3 Pattern
 - 2.2.1.4 Minimum NRC
 - 2.2.1.5 Minimum Light Reflectance Coefficient
 - 2.2.1.6 Nominal Size
 - 2.2.1.7 Edge Detail
 - 2.2.1.8 Finish
 - 2.2.2 Units for Exposed-Grid System ACP-2
 - 2.2.2.1 Type
 - 2.2.2.2 Flame Spread
 - 2.2.2.3 Pattern
 - 2.2.2.4 Minimum NRC
 - 2.2.2.5 Minimum Light Reflectance Coefficient
 - 2.2.2.6 Nominal Size
 - 2.2.2.7 Edge Detail
 - 2.2.2.8 Finish
 - 2.2.2.9 Minimum CAC
- 2.3 SUSPENSION SYSTEM
- 2.4 HANGERS
 - 2.4.1 Wires
- 2.5 ACCESS PANELS

- 2.6 ADHESIVE
- 2.7 FINISHES
- 2.8 COLORS AND PATTERNS
- 2.9 ACOUSTICAL SEALANT

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Suspension System
 - 3.1.1.1 Plumb Hangers
 - 3.1.1.2 Splayed Hangers
 - 3.1.2 Wall Molding
 - 3.1.3 Acoustical Units
 - 3.1.4 Acoustical Sealant
 - 3.1.5 Adhesive Application
- 3.2 CEILING ACCESS PANELS
- 3.3 CLEANING
- 3.4 RECLAMATION PROCEDURES

-- End of Section Table of Contents --

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 A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
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 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 E413	(2016) Classification for Rating Sound Insulation
ASTM E580/E580M	(2020) Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions
ASTM E795	(2016) Standard Practices for Mounting Test Specimens During Sound Absorption Tests
ASTM E1111/E1111M	(2014) Standard Test Method for Measuring the Interzone Attenuation of Open Office Components

ASTM E1264	(2019) Acoustical Ceiling Products
ASTM E1414/E1414M	(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
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. 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 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

Approved Detail Drawings; G, AE

SD-03 Product Data

Acoustical Ceiling Systems; G, AE

Fire Resistive Ceilings; G, AE

Recycled Content for Type IV Ceiling Tiles; S

Recycled Content for Type XII Ceiling Tiles; S

Recycled Content for Suspension Systems; S

Acoustical Performance; G, AE

SD-04 Samples

Acoustical Units; G

Acoustical Ceiling Tiles; G

SD-06 Test Reports

Fire Resistive Ceilings; G

SD-07 Certificates

Indoor Air Quality for Type IV Ceiling Tiles; S

Indoor Air Quality for Type XII Ceiling Tiles; S

Indoor Air Quality for Adhesives; S

Indoor Air Quality for Sealants; S

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 ten years 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. The Contractor has the option to substitute inch-pound (I-P) Recessed Light Fixtures (RLF) for metric RLF. If the Contractor opts to provide I-P RLF, then provide I-P products for other ceiling elements like acoustical ceiling tiles, air diffusers, air registers and grills. Coordinate the entire ceiling system with other details, like the location of access panels and ceiling penetrations, for instance, shown on the drawings. The Contractor is responsible for the final assembly and performance of the specified work and products if I-P products are used. Provide the location and extent of acoustical treatment as shown on the approved detail drawings. Submit drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan. Coordinate with paragraph RECLAMATION PROCEDURES for reclamation of mineral fiber acoustical ceiling panels to be removed from the job site.

2.1.1 Fire Resistive Ceilings

Rate acoustical ceiling systems, indicated as fire resistant, for fire endurance as specified when tested in accordance with ASTM E119. Test suspended ceiling with a specimen floor assembly representative of the indicated construction, including mechanical and electrical work within ceiling space openings for light fixtures, and air outlets, and access panels. Provide ceiling assembly rating as shown on drawings. Provide acoustical units with a flame spread of 25 or less and smoke development

of 50 or less when tested in accordance with ASTM E84.

2.1.2 Acoustical Performance

2.1.2.1 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.

2.1.2.2 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C423. Determine Articulation Class (AC) in accordance with ASTM E1111/E1111M.

2.1.3 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 ACP-1

2.2.1.1 Type

XII (fiberglass base with membrane-faced overlay). Provide Type XII Acoustical Ceiling Tiles containing a minimum of 25 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

E

2.2.1.4 Minimum NRC

1.00 when tested on mounting Type E-400 of ASTM E795.

2.2.1.5 Minimum Light Reflectance Coefficient

LR-1, 0.75 or greater

2.2.1.6 Nominal Size

24 by 24 inch

2.2.1.7 Edge Detail

Square Tegular

2.2.1.8 Finish

Factory-applied standard finish. See paragraph COLORS AND STANDARDS.

2.2.2 Units for Exposed-Grid System ACP-2

2.2.2.1 Type

IV (non-asbestos mineral fiber with membrane-faced overlay). Provide Type IV Acoustical Ceiling Tiles containing a minimum of 60 percent recycled content. Provide data identifying percentage of recycled content for Type IV ceiling tiles. Provide certification of indoor air quality for Type IV Ceiling Tiles.

2.2.2.2 Flame Spread

Class A, 25 or less

2.2.2.3 Pattern

E

2.2.2.4 Minimum NRC

0.75 when tested on mounting Type B or Type E-400 of ASTM E795

2.2.2.5 Minimum Light Reflectance Coefficient

LR-1, 0.75 or greater

2.2.2.6 Nominal Size

24 by 24 inch

2.2.2.7 Edge Detail

Square Lay-In

2.2.2.8 Finish

Factory-applied standard finish. See paragraph COLORS AND PATTERNS.

2.2.2.9 Minimum CAC

35

2.3 SUSPENSION SYSTEM

Provide standard suspension system conforming to ASTM C635/C635M. Provide surfaces exposed to view of aluminum or steel with a factory-applied white baked-enamel finish. Provide wall molding having a flange of not less

than 15/16 inch . Provide standard corners. Provide a suspension system with a maximum deflection of 1/360 of the span length capable of supporting the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Conform seismic details to the guidance in UFC 3-301-01 and ASTM E580/E580M.

Provide Suspension System containing a minimum of 15 percent recycled content. Provide data identifying percentage of recycled content for suspension systems.

2.4 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.4.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.08 inch (12 gauge) in diameter.

2.5 ACCESS PANELS

Provide access panels that match adjacent acoustical units, designed and equipped with suitable framing and fastenings for removal and replacement without damage. Size panel to be not less than 12 by 12 inch or more than 12 by 24 inch.

- a. Attach an identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, near one corner on the face of each access panel.
- b. Identify ceiling access panel by a number utilizing white identification plates or plastic buttons with contrasting numerals. Provide plates or buttons of minimum 1 inch diameter and securely attached to one corner of each access unit. Provide a typewritten card framed under glass listing the code identification numbers and corresponding system descriptions listed above. Mount the framed card where directed and furnish a duplicate card to the Contracting Officer. Code identification system is as follows:

- (1) Fire detection/alarm system
- (2) Air conditioning controls
- (3) Plumbing system
- (4) Heating and steam systems
- (5) Air conditioning duct system
- (6) Sprinkler system
- (7) Intercommunication system

2.6 ADHESIVE

Use adhesive as recommended by tile 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 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of GS-36. For products located on the interior of the building (inside of the weatherproofing system), provide certification or validation of indoor air quality for adhesives.

2.7 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.

2.8 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

2.9 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C834, nonstaining. For products located on the interior of the building (inside of the weatherproofing system), 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 Acoustical Sealant

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.

3.4 RECLAMATION PROCEDURES

Neatly stack completely dry ceiling tile, designated for recycling by the Contracting Officer, on 4 by 4 foot pallets not higher than 4 foot.

Shrink wrap and symmetrically stack pallets on top of each other without falling over.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 62 38

STATIC-CONTROL FLOORING

08/17, CHG 1: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SCHEDULING
- 1.3 SUBMITTALS
 - 1.3.1 Samples
 - 1.3.1.1 Static-Control Resilient Flooring
 - 1.3.1.2 Moldings
 - 1.3.1.3 Operations and Maintenance Data
- 1.4 CERTIFICATIONS
 - 1.4.1 Indoor Air Quality Certifications
 - 1.4.1.1 Floor Covering Materials
 - 1.4.1.2 Adhesives
- 1.5 EXTRA MATERIALS
- 1.6 QUALITY ASSURANCE
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - 1.7.1 Static-Control Resilient Flooring
- 1.8 ENVIRONMENTAL CONDITIONS
 - 1.8.1 Static-Control Resilient Flooring
- 1.9 WARRANTY
 - 1.9.1 Static-Control Resilient Flooring

PART 2 PRODUCTS

- 2.1 STATIC-CONTROL RESILIENT FLOORING
 - 2.1.1 Static-Dissipative Resilient Flooring
 - 2.1.1.1 Static-Dissipative Vinyl Tile
- 2.2 WALL BASE
 - 2.2.1 Resilient Base
- 2.3 ADHESIVES
- 2.4 MOLDINGS
- 2.5 ACCESSORIES
- 2.6 ELECTRICAL GROUND CONNECTION
- 2.7 MANUFACTURER'S COLOR, PATTERN AND TEXTURE
- 2.8 FIRE RESISTANCE TESTING REQUIREMENTS

PART 3 EXECUTION

- 3.1 SURFACE PREPARATION
- 3.2 MOISTURE, ALKALINITY AND BOND TESTS
- 3.3 GENERAL INSTALLATION
- 3.4 INSTALLATION OF STATIC-CONTROL RESILIENT TILE FLOORING
- 3.5 INSTALLATION OF WALL BASE
 - 3.5.1 Resilient Base
- 3.6 CLEANING AND PROTECTION
- 3.7 TESTING

-- End of Section Table of Contents --

SECTION 09 62 38

STATIC-CONTROL FLOORING

08/17, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E648	(2019a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F150	(2006; R 2013) Standard Test Method for Electrical Resistance of Conductive and Static Dissipative 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
--------------------	--

ELECTROSTATIC DISCHARGE ASSOCIATION (ESD)

ESD S6.1	(2019) Standard for the Protection of Electrostatic Discharge Susceptible Items - Grounding
----------	---

GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use
-------	-------------------------------------

RESILIENT FLOOR COVERING INSTITUTE (RFCI)

FLOORSCORE	FLOORSCORE IAQ Certification
------------	------------------------------

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 SCHEDULING

Schedule static-control flooring work after any other work which would damage the finished surface of the flooring.

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-03 Product Data

Static-Control Resilient Flooring; G

Accessories; G

Adhesives; G

Warranty

SD-04 Samples

Static-Control Resilient Flooring; G

Moldings; G

Accessories; G

SD-06 Test Reports

Fire Resistance

Moisture, Alkalinity and Bond

Testing

SD-07 Certificates

Indoor Air Quality for Static-Dissipative Vinyl Tile; S

Indoor Air Quality for Adhesives; S

Qualifications of Applicator

SD-08 Manufacturer's Instructions

Static-Control Resilient Flooring; G

Accessories; G

SD-10 Operation and Maintenance Data

Static-Control Resilient Flooring; G

Accessories; G

1.3.1 Samples

1.3.1.1 Static-Control Resilient Flooring

Submit three samples of each indicated color and type of flooring, base, moldings, and accessories sized a minimum 2-1/2 by 4 inch.

1.3.1.2 Moldings

Submit three pieces of each type at least 12 inches long.

1.3.1.3 Operations and Maintenance Data

- a. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.
- b. Submit three copies of manufacturer's maintenance instructions for each type of flooring material describing recommended type of cleaning equipment and materials, spotting and cleaning methods, and cleaning cycles.

1.4 CERTIFICATIONS

1.4.1 Indoor Air Quality Certifications

1.4.1.1 Floor Covering Materials

Provide Static-Dissipative 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 or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body.

1.4.1.2 Adhesives

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.

1.5 EXTRA MATERIALS

Provide extra material from same dye lot for future maintenance. Provide a minimum of 5 percent of total square yards of each flooring and base type, pattern, and color.

1.6 QUALITY ASSURANCE

The flooring manufacturer will approve the Qualifications of Applicator and certify that he/she has a minimum of 3 years of experience in the application of the materials to be used.

1.7 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, size, production run, project identification, handling instructions and related information. Observe ventilation and safety procedures specified in the Safety Data Sheets (SDS). Do not store flooring near materials that may off-gas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.7.1 Static-Control Resilient Flooring

Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature range as recommended by the manufacturer but not less than 68 degrees F or more than 85 degrees F. Stack materials according to manufacturer's recommendations. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances.

1.8 ENVIRONMENTAL CONDITIONS

Provide temporary ventilation during work of this section.

1.8.1 Static-Control Resilient Flooring

Maintain areas in which resilient flooring is to be installed at a temperature range as recommended by the manufacturer but not less than 68 degrees F or more than 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 range as recommended by the manufacturer but not less than 55 degrees F thereafter for the duration of the contract. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.9 WARRANTY

1.9.1 Static-Control Resilient Flooring

Provide manufacturer's standard performance guarantees or warranties including a five year wear warranty and ten year conductivity warranty.

PART 2 PRODUCTS

2.1 STATIC-CONTROL RESILIENT FLOORING

2.1.1 Static-Dissipative Resilient Flooring

2.1.1.1 Static-Dissipative Vinyl Tile

Static-dissipative vinyl tile must be a homogeneous vinyl product and conform to ASTM F1700. Provide electrical resistance from surface to surface and surface to ground between 1,000,000 ohms (1.0×10 to the 6th) and 1,000,000,000 ohms (1.0×10 to the 9th) when tested in accordance with ASTM F150. Tile must be 24 inches square and 1/8 inch thick. Tile must be pre-grooved for heat welding of seams. As required, provide welding rods as recommended by the manufacturer.

Provide certification of indoor air quality for Static-Dissipative Vinyl Tile.

2.2 WALL BASE

2.2.1 Resilient Base

Resilient base must conform to ASTM F1861, Type TP (thermoplastic rubber), Style B (coved - installed with resilient flooring). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide job formed corners in matching height, shape, and color.

2.3 ADHESIVES

Provide adhesive as recommended by the manufacturer of the static-control flooring. Provide adhesive for wall base as recommended by the wall base 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 (use the office or classroom requirements, 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 MOLDINGS

Provide heavy duty tapered moldings of vinyl and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on molding of maximum 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2. Provide color to match resilient base.

2.5 ACCESSORIES

Use accessories recommended by the manufacturer of the flooring.

2.6 ELECTRICAL GROUND CONNECTION

Provide an electrical ground connection that meets the requirements of

ESD S6.1. Connection between the static-control floor system and the external grounding system must be provided. Contact with the static-control floor system must be with conductive grounding strip and must have the greater of the following: a minimum contact area of 9 square inch or the dimensions recommended by the manufacturer. Provide the grounding conductor recommended by the manufacturer of the flooring. Connect and install the grounding conductor as recommend by the flooring manufacturer.

2.7 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture as indicated. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern.

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 SURFACE PREPARATION

Before any work under this section is begun, defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces must be corrected, and damaged portions of concrete slabs must be repaired in accordance with flooring manufacturer's recommended instructions. Floor must be in a level plane with a maximum variation of 1/8 inch every 10 feet, except where indicated as sloped. Repair cracks and irregularities and prepare the subfloor in accordance with flooring manufacturer's recommended instructions. Curing and sealing compounds should not be used on concrete surfaces to receive flooring unless they have been tested and approved by the flooring manufacturer. In addition, remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions. If a curing compound is required, it must be coordinated for compatibility with the flooring adhesive.

3.2 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the 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 flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations.

3.3 GENERAL INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

3.4 INSTALLATION OF STATIC-CONTROL RESILIENT TILE FLOORING

Install static-control resilient flooring, ground connections and

accessories in accordance with the approved manufacturer's installation instructions. Tile lines and joints must be kept square, symmetrical, tight, and even. Tile at the perimeter of the area to be finished may vary as necessary to maintain full-size tiles in the field, but no perimeter tile may be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Tile must be cut, fitted, and scribed to walls, partitions, and projections after field flooring has been applied. Install grounding strips in accordance with manufacturer's installation instructions. Protect edges of flooring material meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions.

3.5 INSTALLATION OF WALL BASE

3.5.1 Resilient 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.

3.6 CLEANING AND PROTECTION

The flooring must be cleaned in accordance with the manufacturer's recommendations. Flooring must be protected by a covering of heavy-duty building paper before foot traffic is permitted. Lap and secure edges of kraft paper protection to provide a continuous cover. Boardwalks must be placed over flooring in areas where subsequent building operations might damage the floor. Remove and replace flooring that becomes loose, broken, or curled prior to acceptance, or flooring that does not conform to resistance requirements of ASTM F150.

3.7 TESTING

Test the flooring in accordance with and conform to the requirements of ESD S6.1.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 65 00

RESILIENT FLOORING

08/10, CHG 3: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATES
 - 1.3.1 Indoor Air Quality
 - 1.3.1.1 Floor Covering Materials
 - 1.3.1.2 Adhesives
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 ENVIRONMENTAL REQUIREMENTS
- 1.6 SCHEDULING
- 1.7 WARRANTY
- 1.8 EXTRA MATERIALS

PART 2 PRODUCTS

- 2.1 RUBBER TILE
- 2.2 LUXURY VINYL TILE
- 2.3 WALL BASE
- 2.4 STAIR TREADS AND RISERS
- 2.5 MOULDING
- 2.6 ADHESIVES
- 2.7 SURFACE PREPARATION MATERIALS
- 2.8 POLISH/FINISH
- 2.9 CAULKING AND SEALANTS
- 2.10 MANUFACTURER'S COLOR, PATTERN AND TEXTURE
- 2.11 FIRE RESISTANCE TESTING REQUIREMENTS

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 SURFACE PREPARATION
- 3.3 MOISTURE, ALKALINITY AND BOND TESTS
- 3.4 GENERAL INSTALLATION
- 3.5 PLACING LUXURY VINYL TILES
- 3.6 PLACING RUBBER TILE
- 3.7 PLACING MOULDING
- 3.8 PLACING WALL BASE
- 3.9 PLACING STAIR TREADS AND RISERS
- 3.10 CLEANING
- 3.11 PROTECTION

-- End of Section Table of Contents --

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	(2019; E 2020) Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
ASTM F1344	(2015) Rubber Floor Tile
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 F2169	(2015; R 2020; E 2020) Standard Specification for Resilient Stair Treads
ASTM F2170	(2019a) Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
--------------------	--

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

SD-03 Product Data

Resilient Flooring and Accessories; G

Adhesives; G

Recycled content for Wall Base; S

Luxury Vinyl Tile

Rubber Tile

Wall Base

Stair Treads and Risers

SD-04 Samples

Resilient Flooring and Accessories; G

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests; G

SD-07 Certificates

Indoor Air Quality for Rubber Tile; S

Indoor Air Quality for Luxury Vinyl Tile; S

Indoor Air Quality for Wall Base; S

Indoor Air Quality for Adhesives; S

SD-08 Manufacturer's Instructions

Surface Preparation; G

Installation; G

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories; G

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, rubber tile, and wall base certified to meet California Department of Public Health (CDPH) Standard Method, FLOORSORE, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold. Submit product data for indoor air quality for luxury vinyl tile, indoor air quality for rubber tile, and indoor air quality for wall base.

1.3.1.2 Adhesives

Provide adhesives applied within the building interior certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for adhesives.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store exposed rubber surface materials in occupied spaces. Do not store near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.5 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.6 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.7 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

1.8 EXTRA MATERIALS

Provide extra flooring material of each color and pattern at the rate of 5 tiles for each 1000 tiles installed. Provide extra wall base material composed of 20 linear feet of each type, color and pattern. Package all extra materials in original properly marked containers bearing the manufacturer's name, brand name, pattern color name and number, production run, and handling instructions. Provide extra materials from the same lot as those installed. Leave extra stock at the site in location assigned by Contracting Officer.

PART 2 PRODUCTS

2.1 RUBBER TILE

Conform to ASTM F1344 Class 1 homogeneous, (solid color), 24 inch square. Provide square surface studs with chamfered edges. Provide high stud profile. Provide 0.125 inch overall thickness. .

Provide certification of indoor air quality for Rubber Tile.

2.2 LUXURY VINYL TILE

Conform to ASTM F1700 Class III printed film with a minimum wear layer thickness 0.020 inch (20 mil) and minimum overall thickness 0.197 inch, Type A (smooth). Provide 20 by 20 inch square tile. 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.

Provide certification of indoor air quality for Luxury Vinyl Tile.

2.3 WALL BASE

Conform to ASTM F1861, Type TP (thermoplastic rubber). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide job formed corners in matching height, shape, and color. Provide wall base containing a minimum of 10 percent recycled content. Provide product data identifying percentage of recycled content for wall base.

Provide certification of indoor air quality for Wall Base.

2.4 STAIR TREADS AND RISERS

Conform to ASTM F2169, Type TP (thermoplastic rubber). Conform to ASTM F2169 for surface of treads Class 2 raised square, Group 2 strip for visually impaired of contrasting color of abrasive material. Provide square nosing. Provide either a one piece nosing/tread/riser or a two piece nosing/tread design with a matching coved riser.

2.5 MOULDING

Provide tapered mouldings of rubber and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 1/4 inch. Provide color as indicated on drawings.

2.6 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics.

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.7 SURFACE PREPARATION MATERIALS

Provide surface preparation materials, such as panel type underlayment, lining felt, and floor crack fillers as recommended by the flooring manufacturer for the subfloor conditions. Comply with ASTM F1482 for panel type underlayment products. Use one of the following substrates:

a. Concrete.

2.8 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D4078 for polish.

2.9 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.10 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. 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.

2.11 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 using glue down installation. Install flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions for installation method specified. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.6 PLACING RUBBER TILE

Install rubber tile and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Vary width of edge tiles as necessary to maintain full-size tiles, except where irregular-shaped rooms makes it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied.

3.7 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. Secure moulding with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed directions. Anchor aluminum moulding to floor surfaces as recommended by the manufacturer.

3.8 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.9 PLACING STAIR TREADS AND RISERS

Secure and install stair treads and risers in accordance with

manufacturer's printed installation instructions. Cover the surface of treads and risers the full width of the stairs. Provide equal length pieces butted together to cover the treads and risers for stairs wider than manufacturer's standard lengths.

3.10 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry and clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions and within the recommended time frame. As required by the manufacturer, apply the recommended number of coats and type of polish and finish in accordance with manufacturer's written instructions.

3.11 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 68 00

CARPETING

11/17, CHG 2: 08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality Certifications
 - 1.3.1.1 Floor Covering Materials
 - 1.3.1.2 Adhesives
 - 1.3.1.3 Primer and Sealer
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 AMBIENT CONDITIONS
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 CARPET
 - 2.1.1 Recycled Content
 - 2.1.2 Indoor Air Quality Requirements
 - 2.1.3 Physical Characteristics for Modular Tile and Entrance Carpet
 - 2.1.3.1 Carpet Type CPT-1
 - 2.1.3.2 Carpet Type CPT-2
 - 2.1.3.3 Carpet Type CPT-3
- 2.2 PERFORMANCE REQUIREMENTS
 - 2.2.1 Texture Appearance Retention Rating (TARR)
 - 2.2.2 Static Control
 - 2.2.3 Flammability and Critical Radiant Flux Requirements
 - 2.2.4 Tuft Bind
 - 2.2.5 Colorfastness to Crocking
 - 2.2.6 Colorfastness to Light
 - 2.2.7 Colorfastness to Water
 - 2.2.8 Delamination Strength
 - 2.2.9 Antimicrobial
- 2.3 ADHESIVES AND CONCRETE PRIMER
- 2.4 MOLDINGS
- 2.5 COLOR, TEXTURE, AND PATTERN

PART 3 EXECUTION

- 3.1 SURFACE PREPARATION
- 3.2 MOISTURE AND ALKALINITY TESTS
- 3.3 PREPARATION OF CONCRETE SUBFLOOR
- 3.4 INSTALLATION
 - 3.4.1 Modular Tile Installation
 - 3.4.2 Entrance Carpet Installation
- 3.5 CLEANING AND PROTECTION
 - 3.5.1 Cleaning

- 3.5.2 Protection
- 3.6 REMNANTS
- 3.7 MAINTENANCE
 - 3.7.1 Extra Materials

-- End of Section Table of Contents --

SECTION 09 68 00

CARPETING

11/17, CHG 2: 08/20

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16	(2004; E 2008; E 2010) Colorfastness to Light
AATCC 107	(2013) Colorfastness to Water
AATCC 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 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

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2551 (2020) Textile Floor Coverings and Textile Floor Coverings in Tile Form- Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions and Distortion Out of Plane

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

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; G

SD-03 Product Data

Carpet; G

Recycled Content for Carpeting; S

Moldings; G

Indoor Air Quality for Aerosol Adhesives; S

Indoor Air Quality for Non-Aerosol Adhesives; S

Indoor Air Quality for Concrete Primer; S

SD-04 Samples

Carpet; G

Moldings; G

SD-06 Test Reports

Moisture and Alkalinity Tests; G

SD-07 Certificates

Indoor Air Quality for Carpet; S

Indoor Air Quality for Adhesives; S

Indoor Air Quality for Concrete Primer and Sealer; 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

Submit required indoor air quality certifications in one submittal package.

1.3.1.1 Floor Covering Materials

Provide carpet certified to meet California Department of Public Health (CDPH) Standard Method, FLOORSORE, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold, Carpet and Rug Institute's Green Label Plus Program. Submit product data for indoor air quality for carpet.

1.3.1.2 Adhesives

Provide adhesives certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for adhesives.

1.3.1.3 Primer and Sealer

Provide primer and sealer certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of Green Seal GS-11, California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings, or SCAQMD Rule 1113. Submit product data for indoor air quality for concrete primer and sealer.

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 protected from damage, soiling, and moisture, and maintain at a temperature above 60 degrees F for 2 days prior to installation. 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 and 2) Moldings. Also, submit Samples of the following:

- a. Carpet: Two "Production Quality" samples 18 by 18 inches of each carpet proposed for use, showing quality, pattern, and color specified
- b. Moldings: Two samples of each type minimum 12 inches long

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 Modular Tile and Entrance Carpet

2.1.3.1 Carpet Type CPT-1

Modular tile 24 by 24 inch square with 0.15 percent growth/shrink rate in accordance with ISO 2551.

- a. Carpet Construction: Tufted
- b. Pile Type: Patterned loop
- c. Pile Fiber: Commercial 100 percent branded (federally registered trademark).
- d. Gauge or Pitch: Minimum 5/64 inch in accordance with ASTM D5793
- e. Stitches or Rows/Wires: Minimum 8.10 per square inch
- f. Surface Pile Weight: Minimum 23 ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D5848.
- g. Pile Thickness: Minimum 0.095 inch in accordance with ASTM D6859
- h. Pile Density: Minimum 8,716 oz/ square yard
- i. Dye Method: Solution dyed
- j. Backing Materials:
Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

2.1.3.2 Carpet Type CPT-2

Modular tile 24 by 24 inch square with 0.15 percent growth/shrink rate in accordance with ISO 2551.

- a. Carpet Construction: Tufted
- b. Pile Type: Patterned loop
- c. Pile Fiber: Commercial 100 percent branded (federally registered trademark).
- d. Gauge or Pitch: Minimum 5/64 inch in accordance with ASTM D5793
- e. Stitches or Rows/Wires: Minimum 10.0 per square inch
- f. Surface Pile Weight: Minimum 21 ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D5848.

- g. Pile Thickness: Minimum 0.098 inch in accordance with ASTM D6859
- h. Pile Density: Minimum 7,714 oz/ square yard
- i. Dye Method: Solution dyed
- j. Backing Materials:
Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet. Provide secondary backing to suit project requirements of those customarily used and accepted by the trade for each type of carpet.

2.1.3.3 Carpet Type CPT-3

Modular tile 24 by 24 inch square with 0.15 percent growth/shrink rate in accordance with ISO 2551.

- a. Carpet Construction: Tufted
- b. Pile Type: Patterned loop
- c. Pile Fiber: Commercial 100 percent branded (federally registered trademark).
- d. Gauge or Pitch: Minimum 1/12 inch in accordance with ASTM D5793
- e. Stitches or Rows/Wires: Minimum 8.0 per square inch
- f. Surface Pile Weight: Minimum 24 ounces per square yard. This does not include weight of backings. Determine weight in accordance with ASTM D5848.
- g. Pile Thickness: Minimum 0.115 inch in accordance with ASTM D6859
- h. Pile Density: Minimum 7,513 oz/ square yard
- i. Dye Method: Solution dyed
- j. Backing Materials:
Provide primary backing materials like those customarily used and accepted by the trade for each type of carpet. 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 3.0 (Heavy) 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 3.0 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 aerosol adhesives. 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 MOLDINGS

Provide carpet moldings where floor covering material changes or carpet edge does not abut a vertical surface. Provide rubber molding designed for the type of carpet being installed. Provide floor flange of a minimum 1 1/2 inches wide. Provide color as indicated on drawings.

2.5 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with the drawings.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep clean. Before beginning work, test subfloor with glue and carpet to determine "open time" and bond. Submit three copies of the manufacturer's printed Installation instructions for the carpet, including Surface Preparation, seaming techniques, and recommended adhesives and tapes.

3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab for moisture content and excessive alkalinity in accordance with CRI 104/CRI 105. Submit three copies of reports of Moisture and Alkalinity Tests including content of concrete slab stating date of test, person conducting the test, and the area tested.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting until concrete substrate is at least 90 days old. Prepare the concrete surfaces in accordance with the carpet manufacturer's instructions. Match carpet, when required, and adhesives to prevent off-gassing to a type of curing compounds, leveling agents, and concrete sealer.

3.4 INSTALLATION

Perform all work by manufacturer's approved installers. Conduct installation in accordance with the manufacturer's printed instructions and CRI 104/CRI 105. Protect edges of carpet meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions. Follow ventilation, personal protection, and other safety precautions recommended by the adhesive manufacturer. Continue ventilation during installation and for at least 72 hours following installation. Do not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation. Complete other work which would damage the carpet prior to installation of carpet. Submit three copies of Installation Drawings for 1) Carpet and 2) Moldings indicating areas receiving carpet, carpet types, patterns, direction of pile, location of seams, and locations of edge molding.

Do not install building construction materials that show visual evidence of biological growth.

3.4.1 Modular Tile Installation

Install modular tiles with manufacturer approved adhesive tab system adhesive and snug joints. Use monolithic installation method for CPT-1 and ashlar installation method for CPT-2. Comply with manufacturer installation instructions for required drying time of releasable adhesive so it sets up properly. Provide accessibility to the subfloor where

required. Carpet tile on stairs and sloped surfaces must be installed with a more permanent installation method in accordance with the manufacturer's instructions and with manufacturer recommended adhesives for this application.

3.4.2 Entrance Carpet Installation

Install tiles with permanent vinyl-compatible adhesive and snug joints. Use monolithic 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.

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. Set aside and return non-retained scraps to manufacturer for recycling into new product.

3.7 MAINTENANCE

3.7.1 Extra Materials

Provide extra material from same dye lot consisting of uncut carpet tiles for future maintenance. Provide a minimum of three percent of total square yards of each carpet type, pattern, and color. Furnish three percent extra of total adhesive tabs.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 84 20

ACOUSTICAL WALL PANELS

08/16, CHG 1: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality Certifications
 - 1.3.2 Acoustic Wall Panels
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 WARRANTY

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Design
- 2.2 FABRIC COVERED ACOUSTICAL WALL PANELS
 - 2.2.1 Panel Width
 - 2.2.2 Panel Height
 - 2.2.3 Thickness
 - 2.2.4 Fabric Covering
 - 2.2.5 Fire Rating for the Complete Composite System
 - 2.2.6 Substrate
 - 2.2.7 Noise Reduction Coefficient (NRC) Range
 - 2.2.8 Edge Detail
 - 2.2.9 Core Type
 - 2.2.10 Mounting Acoustical Panels
- 2.3 COLOR

PART 3 EXECUTION

- 3.1 SURFACE CONDITIONS
- 3.2 INSTALLATION
- 3.3 CLEANING

-- End of Section Table of Contents --

SECTION 09 84 20

ACOUSTICAL WALL PANELS
08/16, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC 16 (2004; E 2008; E 2010) Colorfastness to Light

ASTM INTERNATIONAL (ASTM)

ASTM C423 (2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

ASTM D5034 (2009; R 2017) Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC (2021) International Building Code

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

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

Approved Detail Drawings; G, AE

SD-03 Product Data

Installation; G, AE

Acoustical Wall Panels; G, AE

SD-04 Samples

Acoustical Wall Panels; G

SD-07 Certificates

Acoustical Wall Panels

Indoor Air Quality for Acoustic Wall Panels; S

SD-11 Closeout Submittals

Warranty

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.3.2 Acoustic Wall Panels

Provide acoustic wall panels certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold. Submit product data for indoor air quality for acoustic wall panels.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect materials delivered and placed in storage from the weather, humidity and temperature variations, dirt, dust, or other contaminants.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Design

Provide fabric wrapped mineral / glass-fiber core acoustical wall panel materials in the manufacturer's standard sizes and finishes of the type, design and configuration indicated.

2.2 FABRIC COVERED ACOUSTICAL WALL PANELS

Provide acoustical wall panels consisting of prefinished, factory

assembled, seamless fabric covered, fiber glass or mineral fiber core system as described below manufactured to the dimensions and configurations shown on the approved detail drawings; submit drawings showing plan locations, elevations and details of method of anchorage, location of doors and other openings, base detail and shape and thickness of materials. Perimeter edges must be non-reinforced. Acoustical wall panels installed in non-sprinklered areas must comply with the requirements of ICC IBC, Standard 42-2. Submit manufacturer's descriptive data and catalog cuts; fabric and vinyl swatches, minimum 18 inches wide by 24 inches long 3 samples of each color range specified; and certificates of compliance from an independent laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards. A label or listing from the testing laboratory will be acceptable evidence of compliance. Wall panels must conform to the following:

2.2.1 Panel Width

Panel width must be as detailed.

2.2.2 Panel Height

Panel height must be as detailed.

2.2.3 Thickness

Panel thickness as required to meet the indicated NRC range.

2.2.4 Fabric Covering

Seamless plain woven 56% polyester and 44% non-phthalate vinyl blend with an acrylic backing, minimum 25 linear yard. Tear strength a minimum 29 pounds. Tensile strength 150 pounds minimum in accordance with ASTM D5034.

Stretch fabric covering free of wrinkles and then bond to the edges and back or bond directly to the panel face, edges, and back of panel a minimum distance standard with the manufacturer. Light fastness (fadeometer) approximately 40 hours in accordance with AATCC 16.

2.2.5 Fire Rating for the Complete Composite System

Class A, 200 or less smoke density and flame spread less than 25, when tested in accordance with ASTM E84.

2.2.6 Substrate

Fiber glass or mineral fiber

2.2.7 Noise Reduction Coefficient (NRC) Range

0.80-0.90 ASTM C423

2.2.8 Edge Detail

Square edge with fabric wrapped on all four sides.

2.2.9 Core Type

Acoustical/tackable core

2.2.10 Mounting Acoustical Panels

Mount acoustical panels as detailed on drawings. Refer to I-505 for panel details.

2.3 COLOR

As indicated. Color listed is not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

mustshall be clean, smooth, oil free and prepared in accordance with panel manufacturer's instructions. Do not begin installation until all wet work, such as, plastering, painting, and concrete are completely dry.

3.2 INSTALLATION

Panel installation must be by personnel familiar with and normally engaged in installation of acoustical wall panels. Apply panels in accordance with the manufacturer's installation instructions. Submit manufacturer's installation instructions and recommended cleaning instructions.

3.3 CLEANING

Following installation, clean dirty or stained panel surfaces in accordance with manufacturer's instructions and leave free from defects. Remove and replace panels that are damaged, discolored, or improperly installed.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 90 00

PAINTS AND COATINGS

02/21

PART 1 GENERAL

- 1.1 RELATED REQUIREMENTS
 - 1.1.1 Painting Included
 - 1.1.1.1 Exterior Painting
 - 1.1.1.2 Interior Painting
 - 1.1.2 Painting Excluded
 - 1.1.3 Mechanical and Electrical Painting
 - 1.1.3.1 Fire Extinguishing Sprinkler Systems
- 1.2 REFERENCES
- 1.3 DEFINITIONS
 - 1.3.1 Qualification Testing
 - 1.3.2 Batch Quality Conformance Testing
 - 1.3.3 Coating
 - 1.3.4 DFT or dft
 - 1.3.5 DSD
 - 1.3.6 EXT
 - 1.3.7 INT
 - 1.3.8 Loose Paint
 - 1.3.9 mil / mils
 - 1.3.10 MPI Gloss Levels
 - 1.3.11 MPI System Number
 - 1.3.12 Paint
 - 1.3.13 REX
 - 1.3.14 RIN
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Regulatory Requirements
 - 1.5.1.1 Environmental Protection
 - 1.5.1.2 Lead Content
 - 1.5.1.3 Chromate Content
 - 1.5.1.4 Asbestos Content
 - 1.5.1.5 Mercury Content
 - 1.5.1.6 Silica
 - 1.5.1.7 Human Carcinogens
 - 1.5.1.8 Carbon Based Fibers / Tubes
 - 1.5.2 Coating Contractor's Qualification
 - 1.5.3 Approved Products List
 - 1.5.4 Paints and Coatings Indoor Air Quality Certifications
 - 1.5.5 Field Samples and Tests
 - 1.5.5.1 Sampling Procedure
 - 1.5.5.2 Testing Procedure
- 1.6 PACKAGING, LABELING, AND STORAGE
- 1.7 SAFETY AND HEALTH
 - 1.7.1 Toxic Materials
- 1.8 ENVIRONMENTAL REQUIREMENTS

1.8.1 Coatings

PART 2 PRODUCTS

- 2.1 MATERIALS
- 2.2 COLOR SELECTION OF FINISH COATS

PART 3 EXECUTION

- 3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED
- 3.2 SURFACE PREPARATION
- 3.3 PREPARATION OF METAL SURFACES
 - 3.3.1 New Ferrous Surfaces
 - 3.3.2 Final Ferrous Surface Condition:
 - 3.3.2.1 Tool Cleaned Surfaces
 - 3.3.2.2 Abrasive Blast Cleaned Surfaces
 - 3.3.2.3 Waterjet Cleaned Surfaces
 - 3.3.3 Galvanized Surfaces
 - 3.3.4 Non-Ferrous Metallic Surfaces
 - 3.3.5 Terne-Coated Metal Surfaces
- 3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE
 - 3.4.1 Concrete and Masonry
 - 3.4.2 Gypsum Board
 - 3.4.2.1 Surface Cleaning
 - 3.4.2.2 Repair of Minor Defects
 - 3.4.2.3 Allowable Moisture Content
- 3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES
 - 3.5.1 New Plywood and Wood Surfaces, Except Floors:
 - 3.5.2 Interior Wood Surfaces, Stain Finish
- 3.6 APPLICATION
 - 3.6.1 Coating Application
 - 3.6.2 Mixing and Thinning of Paints
 - 3.6.3 Two-Component Systems
 - 3.6.4 Coating Systems
- 3.7 COATING SYSTEMS FOR METAL
- 3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES
- 3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD
- 3.10 PIPING IDENTIFICATION
- 3.11 INSPECTION AND ACCEPTANCE
- 3.12 WASTE MANAGEMENT
- 3.13 PAINT TABLES
 - 3.13.1 Exterior Paint Tables
 - 3.13.1.1 MPI Division 5: Exterior Metal, Ferrous and Non-Ferrous Paint Table
 - 3.13.2 Interior Paint Tables
 - 3.13.2.1 MPI Division 3: Interior Concrete Paint Table
 - 3.13.2.2 MPI Division 4: Interior Concrete Masonry Units Paint Table
 - 3.13.2.3 MPI Division 5: Interior Metal, Ferrous and Non-Ferrous Paint Table
 - 3.13.2.4 MPI Division 6: Interior Wood Paint Table
 - 3.13.2.5 MPI Division 9: Interior Gypsum Board Paint Table

-- End of Section Table of Contents --

SECTION 09 90 00

PAINTS AND COATINGS

02/21

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

- a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
- b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
- c. Existing coated surfaces that are damaged during performance of the work.

1.1.1.1 Exterior Painting

Includes new surfaces of the building and appurtenances.

1.1.1.2 Interior Painting

Includes new 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 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 D235	(2002; R 2012) Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D523	(2014; R 2018) Standard Test Method for Specular Gloss
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 3	(2016) Primer, Alkali Resistant, Water Based
MPI 4	(2016) Interior/Exterior Latex Block Filler
MPI 8	(2016) Alkyd, Exterior Flat (MPI Gloss Level 1)
MPI 9	(2016) Alkyd, Exterior Gloss (MPI Gloss Level 6)
MPI 23	(2015) Primer, Metal, Surface Tolerant
MPI 39	(2018) Primer, Latex, for Interior Wood
MPI 42	(2012) Textured Coating, Latex, Flat
MPI 45	(2016) Primer Sealer, Interior Alkyd
MPI 47	(2016) Alkyd, Interior, Semi-Gloss (MPI Gloss Level 5)
MPI 48	(2016) Alkyd, Interior, Gloss (MPI Gloss Level 6-7)
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 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 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)
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 151	(2016) Light Industrial Coating, Interior, Water Based (MPI Gloss Level 3)
MPI 153	(2016) Light Industrial Coating, Interior, Water Based, Semi-Gloss (MPI Gloss Level 5)
MPI 154	(2016) Light Industrial Coating, Interior, Water Based, Gloss (MPI Gloss Level 6)
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

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

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 SP 1 (2015) Solvent Cleaning

SSPC SP 2 (2018) Hand Tool Cleaning

SSPC SP 3 (2018) Power Tool Cleaning

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

SSPC SP 10/NACE No. 2 (2007) Near-White Blast Cleaning

SSPC VIS 1 (2002; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

SSPC VIS 3 (2004) Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning

SSPC VIS 4/NACE VIS 7 (1998; E 2000; E 2004) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting

SSPC-SP WJ-1/NACE WJ-1 (2012) Clean to Bare Substrate, Waterjet Cleaning of Metals

SSPC-SP WJ-2/NACE WJ-2 (2012) Very Thorough Cleaning, Waterjet Cleaning of Metals

SSPC-SP WJ-3/NACE WJ-3 (2012) Thorough Cleaning, Waterjet Cleaning of Metals

SSPC-SP WJ-4/NACE WJ-4 (2012) Light Cleaning, Waterjet Cleaning of Metals

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1113 (2016) Architectural Coatings

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) 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. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24 (2000) Determination of Volatile Matter
Content, Water Content, Density, Volume
Solids, and Weight Solids of Surface
Coatings

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

UNDERWRITERS LABORATORIES (UL)

UL 2818 (2013) GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings

1.3 DEFINITIONS

1.3.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third-party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.3.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing must be accomplished by an MPI testing lab.

1.3.3 Coating

SSPC Glossary; (1) A liquid, liquefiable, or mastic composition that is converted to a solid protective, decorative, or functional adherent film after application as a thin layer; (2) Generic term for paint, lacquer, enamel.

1.3.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.3.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five levels are generically defined under the Assessment sections in the MPI MRM, MPI Maintenance Repainting Manual.

1.3.6 EXT

MPI short term designation for an exterior coating system.

1.3.7 INT

MPI short term designation for an interior coating system.

1.3.8 Loose Paint

Paint or coating that can be removed with a dull putty knife.

1.3.9 mil / mils

The English measurement for 0.001 in or one one-thousandth of an inch.

1.3.10 MPI Gloss Levels

MPI system of defining gloss. Seven gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degree angle	Units at 80 degree angle
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.3.11 MPI System Number

The MPI coating system number in each MPI Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN).

1.3.12 Paint

SSPC Glossary; (1) Any pigmented liquid, liquefiable, or mastic composition designed for application to a substrate in a thin layer that is converted to an opaque solid film after application. Used for protection, decoration, identification, or to serve some other functional purposes; (2) Application of a coating material.

1.3.13 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.3.14 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

1.4 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; G

Product Data Sheets

SD-04 Samples

Color; G

SD-07 Certificates

Qualification Testing laboratory for coatings; G

Indoor Air Quality for Paints and Primers; S

Indoor Air Quality for Consolidated Latex Paints; S

SD-08 Manufacturer's Instructions

Mixing

Manufacturer's Safety Data Sheets

SD-10 Operation and Maintenance Data

Coatings, Data Package 1; G

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

1.5.1.1 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.

1.5.1.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.1.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.1.4 Asbestos Content

Provide asbestos-free materials.

1.5.1.5 Mercury Content

Provide materials free of mercury or mercury compounds.

1.5.1.6 Silica

Provide abrasive blast media containing no free crystalline silica.

1.5.1.7 Human Carcinogens

Provide materials that do not contain ACGIH 0100 confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.5.1.8 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.

1.5.2 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

1.5.3 Approved Products List

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of Contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire Contract and each coating system is to be from a single manufacturer. Provide all coats on a particular substrate from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

1.5.4 Paints and Coatings Indoor Air Quality Certifications

Provide paint and coating products certified to meet indoor air quality requirements by MPI GPS-1-14, MPI GPS-2-14 and certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of Green Seal GS-11, California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings, or SCAQMD Rule 1113.

Provide certification of Indoor Air Quality for Paints and Primers. Provide certification of Indoor Air Quality for Consolidated Latex Paints. Submit required indoor air quality certifications in one submittal package.

1.5.5 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph SAMPLING PROCEDURE. Test each chosen product as specified in the paragraph TESTING PROCEDURE. Remove products from the job site which do not conform, and replace with new products that conform to the referenced specification. Test replacement products that failed initial testing as specified in the paragraph TESTING PROCEDURE at no cost to the Government.

Another required testing is Batch Quality Conformance Testing to prove conformance of the manufacturer's paint to the specified MPI standard. This testing is accomplished before the materials are delivered to the job site. Provide testing for each paint products. Test paint products as specified in the paragraph TESTING PROCEDURE.

1.5.5.1 Sampling Procedure

Select paint at random from the products that have been delivered to the job site for sample testing. The Contractor must provide one quart samples of the selected paint materials. Take samples in the presence of the Contracting Officer, and label, and identify each sample. Provide labels in accordance with the paragraph PACKAGING, LABELING, AND STORAGE.

1.5.5.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph QUALIFICATION TESTING laboratory for coatings. Include the backup data and summary of the test results within the qualification testing lab report. Provide a summary listing of all the reference specification requirements and the result of each test. Clearly indicate in the summary whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If MPI is chosen to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.6 PACKAGING, LABELING, AND STORAGE

Provide paints in sealed containers that legibly show the Contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Furnish pigmented paints in containers not larger than 5 gallons. Store paints and thinners in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F. Do not store paint, polyurethane, varnish, or wood stain products with materials that have a high capacity to absorb VOC emissions. Do not store paint, polyurethane, varnish, or wood stain products in occupied spaces.

1.7 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.

1.7.1 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The applicable manufacturer's Safety Data Sheets (SDS) or local regulation.
- b. 29 CFR 1910.1000.
- c. ACGIH 0100, threshold limit values.

Submit manufacturer's Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

1.8 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.

1.8.1 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.

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. 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 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Schedule cleaning so that dust and other contaminants will not fall on wet, newly painted surfaces. Spot-prime exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas. Refer to MPI ASM and MPI MRM for additional more specific substrate preparation requirements.

3.3 PREPARATION OF METAL SURFACES

3.3.1 New Ferrous Surfaces

- a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6/NACE No.3, or SSPC SP 10/NACE No. 2. Brush-off blast remaining surface in accordance with SSPC 7/NACE No.4; Water jetting to SSPC-SP WJ-4/NACE WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Protect shop-coated ferrous surfaces from corrosion by treating and touching up corroded areas immediately upon detection.
- 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 and SSPC SP 10/NACE No. 2 / SSPC-SP WJ-2/NACE WJ-2.

3.3.2 Final Ferrous Surface Condition:

3.3.2.1 Tool Cleaned Surfaces

Comply with SSPC SP 2 and SSPC SP 3. Use as a visual reference, photographs in SSPC VIS 3 for the appearance of cleaned surfaces.

3.3.2.2 Abrasive Blast Cleaned Surfaces

Comply with SSPC 7/NACE No.4, SSPC SP 6/NACE No.3, and SSPC SP 10/NACE No. 2. Use as a visual reference, photographs in

SSPC VIS 1 for the appearance of cleaned surfaces.

3.3.2.3 Waterjet Cleaned Surfaces

Comply with SSPC-SP WJ-1/NACE WJ-1, SSPC-SP WJ-2/NACE WJ-2, SSPC-SP WJ-3/NACE WJ-3 or SSPC-SP WJ-4/NACE WJ-4. Use as a visual reference, photographs in SSPC VIS 4/NACE VIS 7 for the appearance of cleaned surfaces.

3.3.3 Galvanized Surfaces

- a. New Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. Completely remove coating by brush-off abrasive blast if the galvanized metal has been passivated or stabilized. Do not "passivate" or "stabilize" new galvanized steel to be coated. If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D6386, Appendix X2, and remove by one of the methods described therein.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D235. Wipe dry with clean, dry cloths.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 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 new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.
 - (2) Fungus and Mold: Wash new surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
 - (3) Paint and Loose Particles: Remove by wire brushing.
 - (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of

hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

- c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.
- d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F1869. In all cases follow manufacturer's recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board

3.4.2.1 Surface Cleaning

Verify that gypsum board is dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint is water-based.

3.4.2.2 Repair of Minor Defects

Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

3.4.2.3 Allowable Moisture Content

Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D4263.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

- a. Surface Cleaning: Clean wood surfaces of foreign matter. Verify that surfaces are free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood.
- b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, one ounce (1/3 cup) household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.
- c. Do not exceed 12 percent moisture content of the wood as measured by a moisture meter in accordance with ASTM D4444, Method A, unless otherwise authorized.
- d. Prime or touch up wood surfaces adjacent to surfaces to receive water-thinned paints before applying water-thinned paints.

- e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.
- f. Cosmetic Repair of Minor Defects:
 - (1) Knots and Resinous Wood: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.
 - (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.
 - (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

3.5.2 Interior Wood Surfaces, Stain Finish

Sand interior wood surfaces to receive stain. Fill oak and other open-grain wood to receive stain with a coat of wood filler not less than 8 hours before the application of stain; remove excess filler and sand the surface smooth.

3.6 APPLICATION

3.6.1 Coating Application

- a. Comply with applicable federal, state and local laws enacted to ensure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.
- b. At the time of application, paint must show no signs of deterioration. Maintain uniform suspension of pigments during application.
- c. Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Use rollers for applying paints and enamels of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.
- d. Only apply paints, except water-thinned types, to surfaces that are completely free of moisture as determined by sight or touch.
- e. Thoroughly work coating materials into joints, crevices, and open spaces. Pay special attention to ensure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.
- f. Apply each coat of paint so that dry film is of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Completely hide all blemishes.

- g. Touch up damaged coatings before applying subsequent coats. Broom clean and clear dust from interior areas before and during the application of coating material.
- h. Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads which have been painted and replace with new sprinkler heads. Unfinished spaces include attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. Upon completion of painting, remove protective covering from sprinkler heads.
- i. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel (MPI 9) applied to a minimum dry film thickness of 1.0 mil in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
- j. 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.
- k. 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.
- l. All fire suppression system valves must be marked with permanent tags indicating normally open or normally closed.
- m. 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.
- n. 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.
- o. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- p. Thermosetting Paints: Apply topcoats over thermosetting paints (epoxies and urethanes) within the overcoat window recommended by the

manufacturer.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. Verify that the written permission includes quantities and types of thinners to use.

When thinning is allowed, thin paints immediately prior to application with not more than one pint of suitable thinner per gallon. The use of thinner does not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning cannot cause the paint to exceed limits on volatile organic compounds. Do not mix paints of different manufacturers.

3.6.3 Two-Component Systems

Mix two-component systems in accordance with manufacturer's instructions. Follow recommendation by the manufacturer for any thinning of the first coat to ensure proper penetration and sealing for each type of substrate.

3.6.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table for Exterior Applications	
MPI Division	Substrate Application
MPI Division 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
MPI Division 5	Interior Metal, Ferrous and Non-Ferrous Paint Table
MPI Division 6	Interior Wood Paint Table
MPI Division 9	Interior Gypsum Board 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.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in MPI Division 5 for Exterior and Interior.

- a. Apply specified ferrous metal primer to steel surfaces on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.
- b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.
- c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.
- d. 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.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in MPI Division 3, 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

- a. Apply coatings of Tables in MPI Division 6 for Interior.
- b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.
- c. Apply stains in accordance with manufacturer's printed instructions.

3.10 PIPING IDENTIFICATION

Piping Identification, Including Surfaces In Concealed Spaces: Provide in accordance with MIL-STD-101. Place stenciling in clearly visible locations. On piping not covered by MIL-STD-101, stencil approved names or code letters, in letters a minimum of 1/2 inch high for piping and a minimum of 2 inches high elsewhere. Stencil arrow-shaped markings on piping to indicate direction of flow using black stencil paint.

3.11 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the

Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.12 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, contact local recyclers to reclaim the materials. Set aside extra paint for future color matches or reuse by the Government. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility for reuse by local organizations.

3.13 PAINT TABLES

All DFT's are minimum values. Use only materials with a MPI GPS-1-14 green check mark having a minimum MPI "Environmentally Friendly" E2 rating based on VOC (EPA Method 24) content levels. Acceptable products are listed in the MPI Green Approved Products List, available at <http://www.specifygreen.com/APL/ProductIdxByMPInum.asp>.

3.13.1 Exterior Paint Tables

3.13.1.1 MPI Division 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) New 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.					

B. Exterior Galvanized Surfaces

(1) New Galvanized 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.				

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.				

3.13.2 Interior Paint Tables

3.13.2.1 MPI Division 3: Interior Concrete Paint Table

A. New Concrete, vertical surfaces, not specified otherwise

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.					

B. Concrete Ceilings, Uncoated

Latex Aggregate

New, uncoated	Primer	Intermediate	Topcoat	System DFT
MPI INT 3.1N-G1 (Flat)	N/A	N/A	MPI 42	Per Manufacturer
Texture - Fine . Surface preparation, number of coats, and primer in accordance with manufacturer's instructions. Topcoat: Coating to match adjacent surfaces.				

C. New Concrete in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high-humidity areas, not otherwise specified except floors

Waterborne Light Industrial Coating					
New, uncoated Existing	Existing, previously painted	Primer	Intermediate	Topcoat	System DFT
MPI INT 3.1L-G3(Eggshell)	MPI RIN 3.1C-G3(Eggshell)	MPI 3	MPI 151	MPI 151	4.8 mils
MPI INT 3.1L-G5(Semigloss)	MPI RIN 3.1C-G5(Semigloss)	MPI 3	MPI 153	MPI 153	4.8 mils
MPI INT 3.1L-G6(Gloss)	MPI RIN 3.1C-G6(Gloss)	MPI 3	MPI 154	MPI 154	4.8 mils
Topcoat: Coating to match adjacent surfaces.					

3.13.2.2 MPI Division 4: Interior Concrete Masonry Units Paint Table

A. New 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					

B. New Concrete masonry units, unless otherwise specified

Waterborne Light Industrial Coating					
New, uncoated Existing	Filler	Primer	Intermediate	Topcoat	System DFT
MPI INT 4.2K-G3(Eggshell)	MPI 4	N/A	MPI 151	MPI 151	11 mils
MPI INT 4.2K-G5(Semigloss)	MPI 4	N/A	MPI 153	MPI 153	11 mils
MPI INT 4.2K-G6(Gloss)	MPI 4	N/A	MPI 154	MPI 154	11 mils
Fill all holes in masonry surface					

3.13.2.3 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

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.				

(1) Metal in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high-humidity areas not otherwise specified except floors, hot metal surfaces, and new prefinished equipment

Alkyd				
New, uncoated Existing	Primer	Intermediate	Topcoat	System DFT
MPI INT 5.1E-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) Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish

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.				

3.13.2.4 MPI Division 6: Interior Wood Paint Table

A. Interior Wood and Plywood

(1) New 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.				

B. Interior New wood surfaces in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas, not otherwise specified

Alkyd				
New, uncoated Existing	Primer	Intermediate	Topcoat	System DFT
MPI INT 6.3B-G5 (Semigloss)	MPI 45	MPI 47	MPI 47	4.5 mils
MPI INT 6.3B-G6 (Gloss)	MPI 45	MPI 48	MPI 48	4.5 mils
Topcoat: Coating to match adjacent surfaces.				

3.13.2.5 MPI Division 9: Interior Gypsum Board Paint Table

A. Interior New Wallboard not otherwise specified

Institutional Low Odor / Low VOC Latex, New

Institutional Low Odor / Low VOC Latex				
New	Primer	Intermediate	Topcoat	System DFT
MPI INT 9.2M-G2 (Flat)	MPI 149	MPI 144	MPI 144	4 mils
MPI INT 9.2M-G3 (Eggshell)	MPI 149	MPI 145	MPI 145	4 mils
MPI INT 9.2M-G4 (Satin)	MPI 149	MPI 146	MPI 146	4 mils
MPI INT 9.2M-G5 (Semigloss)	MPI 149	MPI 147	MPI 147	4 mils

Topcoat: Coating to match adjacent surfaces.
--

B. Interior New Wallboard in toilets, food-preparation, food-serving, restrooms, laundry areas, shower areas, areas requiring a high degree of sanitation, and other high humidity areas, not otherwise specified

Epoxy

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.				

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 14 00.10

EXTERIOR SIGNAGE

08/17, CHG 1: 11/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
 - 1.2.1 Wind Load Requirements
 - 1.2.2 Character Proportions and Heights
- 1.3 SUBMITTALS
- 1.4 QUALIFICATIONS
- 1.5 DELIVERY AND STORAGE
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 MODULAR EXTERIOR SIGNAGE SYSTEM
 - 2.1.1 Free-Standing Base Mount Pylon/Monolith Type Signs
 - 2.1.1.1 Framing
 - 2.1.1.2 Exterior Sheeting Panels
 - 2.1.1.3 Mounting
 - 2.1.1.4 Finishes
 - 2.1.2 Panel And Post/Panel Type Signs
 - 2.1.2.1 Posts
 - 2.1.2.2 Panel Framing System
 - 2.1.2.3 Panels
 - 2.1.2.4 Finishes
 - 2.1.2.5 Mounting
 - 2.1.3 Changeable Letter Directories
 - 2.1.3.1 Frame and Trim
 - 2.1.3.2 Header Plates
 - 2.1.3.3 Fabrication
 - 2.1.3.4 Finishes
 - 2.1.3.5 Mounting
 - 2.1.3.6 Changeable Letters
- 2.2 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS
 - 2.2.1 Graphics
 - 2.2.2 Messages
- 2.3 METAL PLAQUES
- 2.4 DIMENSIONAL BUILDING LETTERS
 - 2.4.1 Fabrication
 - 2.4.2 Typeface
 - 2.4.3 Size
 - 2.4.4 Finish
 - 2.4.5 Mounting
- 2.5 ALUMINUM ALLOY PRODUCTS
- 2.6 ORGANIC COATING
- 2.7 STEEL PRODUCTS
- 2.8 ANCHORS AND FASTENERS

2.9 SHOP FABRICATION AND MANUFACTURE

2.9.1 Factory Workmanship

2.9.2 Dissimilar Materials

2.9.3 Shop Painting

2.10 COLOR, FINISH, AND CONTRAST

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Anchorage

3.1.2 Protection and Cleaning

3.2 FIELD PAINTED FINISH

-- End of Section Table of Contents --

SECTION 10 14 00.10

EXTERIOR SIGNAGE

08/17, 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 WELDING SOCIETY (AWS)

AWS C1.1M/C1.1	(2012) Recommended Practices for Resistance Welding
AWS D1.1/D1.1M	(2020) 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	(2020) 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	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B108/B108M	(2019) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B221 (2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 (2006) Metal Finishes Manual

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 windload speeds as indicated. 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 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

Approved Detail Drawings; G

SD-03 Product Data

Modular Exterior Signage System

Installation

Exterior Signage; G

Wind Load Requirements

SD-04 Samples

Exterior Signage; G

SD-10 Operation and Maintenance Data

Protection and Cleaning; G

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters must be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment must essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials must be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period must be provided.

PART 2 PRODUCTS

2.1 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.

2.1.1 Free-Standing Base Mount Pylon/Monolith Type Signs

2.1.1.1 Framing

Interior framing must consist of aluminum or galvanized steel tube columns welded to companion plates. Perimeter framing must consist of aluminum or steel angle framing welded to the post and plate system as designed. Framing members must be designed to permit access to electrical equipment and panel removal. Mounting must be provided as shown. Framing members of steel must be finished with semi-gloss baked enamel or two-component acrylic polyurethane. Openings must be sealed from moisture and made tamper-proof.

2.1.1.2 Exterior Sheeting Panels

Modular panels must be provided in sizes shown on drawings. Panels must be fabricated a minimum of 0.090 inch thick aluminum. Panels must be heliarc welded to framing system. Top and end panels must be removable and must be secured by 3/16 inch socket head jack nuts. Finish for metal panels must be semi-gloss baked enamel.

2.1.1.3 Mounting

Mount by securing to concrete foundation as indicated.

2.1.1.4 Finishes

Base finish must be semi-gloss baked enamel or two-component acrylic polyurethane. Metal panel system finish must be baked enamel or two-component acrylic polyurethane, as shown.

2.1.2 Panel And Post/Panel Type Signs

2.1.2.1 Posts

One-piece aluminum or galvanized steel posts must be provided with minimum 0.125 inch wall thickness. Posts must be designed to accept panel framing system described. The post must be designed to permit attachment of panel framing system without exposed fasteners. Caps must be provided for each post.

2.1.2.2 Panel Framing System

Panel framing consisting of aluminum sections and interlocking track components must be designed to interlock with posts with concealed fasteners.

2.1.2.3 Panels

Modular message panels must be provided in sizes shown on drawings. Panels must be fabricated a minimum of 0.125 inch aluminum. Panels must be designed to be interchangeable. Panels with metal return sheeting must have welded corners, ground smooth. Panels must be heliarc welded to framing system. Face panels must be removable to provide access to electrical components.

2.1.2.4 Finishes

Post finish must be semi-gloss baked enamel or two-component acrylic polyurethane. Metal panel system finish must be baked enamel or two-component acrylic polyurethane.

2.1.2.5 Mounting

Provide permanent mounting by embedding posts in concrete foundation as indicated.

2.1.3 Changeable Letter Directories

2.1.3.1 Frame and Trim

Aluminum alloy finish must be clear anodized natural.

2.1.3.2 Header Plates

Header plate must consist of background metal matching frame and having raised letters attached through the back.

2.1.3.3 Fabrication

Frames and trim must be assembled with corners welded and mitered to hairline fit, with no exposed fasteners. Removable changeable directory panel must consist of aluminum back with covering backgrooved 1/4 inch on centers to receive letters.

2.1.3.4 Finishes

Post finish must be semi-gloss baked enamel or two-component acrylic polyurethane. Metal panel system finish must be baked enamel or two-component acrylic polyurethane.

2.1.3.5 Mounting

Directories must be mounted to supporting structures with concealed fasteners in accordance with manufacturer's instructions.

2.1.3.6 Changeable Letters

Changeable letters must be upper-case or upper and lower-case helvetica medium. Tabbed vinyl letters and numbers must be furnished in accordance with the drawings and schedule.

2.2 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.2.1 Graphics

Signage graphics must conform to the following:

- a. Message must be applied to panel using the silkscreen process. Silkscreened images must be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art must be defined as artwork that is a first generation pattern of the original specified art. Edges and corners must be clean. Rounded corners, cut or ragged edges, edge buildup, bleeding or surfaces pinholes will not be accepted.

2.2.2 Messages

See drawings and schedule for message content. Typeface: Helvetica medium. Type size as indicated.

2.3 METAL PLAQUES

Design and location of plaques must be as indicated.

2.4 DIMENSIONAL BUILDING LETTERS

2.4.1 Fabrication

Letters must be fabricated from cast aluminum or 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.

2.4.2 Typeface

Typeface must be helvetica medium.

2.4.3 Size

Letter size must be as indicated.

2.4.4 Finish

Baked enamel or two-component acrylic polyurethane finish must be provided.

2.4.5 Mounting

Threaded studs 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.

2.5 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.

2.6 ORGANIC COATING

Clean, prime and give surfaces a semi-gloss baked enamel or two-component acrylic polyurethane finish in accordance with NAAMM AMP 500, AMP 505, with total dry film thickness not less than 1.2 mils.

2.7 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.

2.8 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.

2.9 SHOP FABRICATION AND MANUFACTURE

2.9.1 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.

2.9.2 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.

2.9.3 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.

2.10 COLOR, FINISH, AND CONTRAST

Color must be as indicated on the drawings. Color listed is not intended to limit the selection of equal colors from other manufacturers. For buildings required to be handicapped-accessible, the characters and background of signs must be eggshell, matte, or other non-glare finish. Characters and symbols must contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, plaques, or dimensional letters must be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings; submit drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message must be included. Circuits installed underground must conform to the requirements of Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Steel conduits installed underground and illuminated signage mounted directly on buildings must be in conformance with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Signs must be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces must not be installed until finishes on such surfaces have been completed. Submit manufacturer's installation instructions and cleaning instructions.

3.1.1 Anchorage

Anchorage and fastener materials must be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated must include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work must be protected against damage during construction. Hardware and electrical equipment must be adjusted for proper operation. Glass, frames, and other sign surfaces must be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, cover all project identification, directional, and other signs which may mislead the public. Covering must be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Submit 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 --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 14 00.20

INTERIOR SIGNAGE

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 EXTRA MATERIALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Samples
 - 1.4.2 Detail Drawings
 - 1.4.3 Sign Fabricator
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 SYSTEM REQUIREMENTS
 - 2.1.1 Features
 - 2.1.2 Graphics and Typography
 - 2.1.3 Colors and Finishes
 - 2.1.4 ADA Compliance
 - 2.1.5 Materials and Construction
 - 2.1.6 Basic System Description
 - 2.1.7 Graphics / Typography
- 2.2 ROOM IDENTIFICATION SIGN
 - 2.2.1 Sign Faces
 - 2.2.2 Frame Sizes
 - 2.2.3 Room Identification Tactile Letters
- 2.3 EXIT DOOR TACTILE SIGN
- 2.4 BUILDING DIRECTORIES
 - 2.4.1 Doors
 - 2.4.1.1 Door Glazing
 - 2.4.1.2 Door Construction
 - 2.4.1.3 Door Locks
 - 2.4.2 Fabrication
 - 2.4.3 Non-Illuminated Unit
 - 2.4.3.1 Construction
 - 2.4.3.2 Message Strips
- 2.5 PRESSURE SENSITIVE LETTERS
 - 2.5.1 Fabrication
 - 2.5.2 Size
- 2.6 MATERIALS
 - 2.6.1 Aluminum Alloy Products
 - 2.6.2 Organic Coating
 - 2.6.3 Plastic Laminate Sheet
 - 2.6.4 Fabrication and Manufacture
 - 2.6.4.1 Factory Workmanship
 - 2.6.4.2 Dissimilar Materials

- 2.6.5 Typeface
- 2.7 GRAPHICS
 - 2.7.1 Subsurface Copy
 - 2.7.2 First Surface Copy Direct Print (Non-Tactile)
 - 2.7.3 Photopolymer
- 2.8 COLOR, FINISH, AND CONTRAST

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Anchorage
 - 3.1.2 Protection and Cleaning

-- End of Section Table of Contents --

SECTION 10 14 00.20

INTERIOR SIGNAGE

08/20

PART 1 GENERAL

1.1 REFERENCES

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

ALUMINUM ASSOCIATION (AA)

AA PK-1 (2015) Pink Sheets: Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings & Ingot

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (2015) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M (2014; Errata 1 2014; Errata 2 2020) Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM B209 (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B221 (2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM C1048 (2018) Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1 (2009) Accessible and Usable Buildings and Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3 (2005) Standard for High-Pressure
Decorative Laminates

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (2021) Life Safety Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA)
Accessibility Guidelines for Buildings and
Facilities; Architectural Barriers Act
(ABA) Accessibility Guidelines

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Detail Drawings; G

SD-03 Product Data

Room Identification Sign with Patient Information; G

Exit Door Tactile Sign; G

Building Directories; G

SD-04 Samples

Interior Signage; G

Software; G

Room Identification Sign with Patient Information; G

Exit Door Tactile Sign; G

Building Directories; G

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions; G

Protection and Cleaning; G

1.3 EXTRA MATERIALS

Provide one copy of the software for user produced signs and inserts after project completion and equipment necessary for removal of signage parts

and pieces.

1.4 QUALITY ASSURANCE

1.4.1 Samples

Submit interior signage samples of each of the following sign types showing typical quality, workmanship and color: all sign types included in project. Approved samples may be installed in the work, provided each sample is identified and location recorded.

- a. Sign Type ST - Stair Sign.
- b. Sign Type WR - Women Restroom sign.
- c. Sign Type US-1_- User Space sign.
- d. Sign Type CR - Conference Room sign.
- e. Sign Type RB - Restroom Blade sign.
- f. Sign Type IDS - Interior Directional sign.
- g. Sign Type STX - Stair Exterior Sign.

1.4.2 Detail Drawings

Submit detail drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. Include a schedule showing the location, each sign type, and message.

1.4.3 Sign Fabricator

Sign Fabricator to follow room number strategies created by designer. The room numbering system to be reviewed and approved by the Contracting Officer and command end users during the shop drawing phase, and prior to fabrication.

1.5 DELIVERY, STORAGE, AND HANDLING

Package materials to prevent damage and deterioration during shipment, handling, storage and installation. Deliver products to the jobsite in manufacturer's original packaging and store in a clean, dry area in accordance with manufacturer's instructions.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective interior signage materials and workmanship for a period of 2 years from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

Modular sign and display system shall feature solutions for all required sign types, including but not limited to wall mounted personnel signs, work station personnel signs, primary room identification, directories,

directionals, overhead signs, projection wall signs, free standing signs, restroom signs, regulatory and information signs, stair signs and changeable slide conference room signs. All signs within the system must feature the same family of components and/or convey a uniform look throughout.

2.1.1.1 Features

- a. Sign Frames: Sign frame assemblies shall be comprised of aluminum extrusions with a core material rigid enough to support the sign's display/insert material.
- b. Sign Depth: No wall mounted signs, excluding any decorative backers, should feature a depth greater than 5/8". Wall mounted signs 17"w or less shall feature a maximum depth of 7/16".
- c. Updatibility: Signs must allow for easy updating of message inserts for all sign types and must offer an option of front-loading/re-loading of insert panels.
- d. Tamper Resistance: System must offer an option for a concealed locking method to increase level of tamper resistance.
- e. Mounting: Signs must be able to accommodate installation via fully concealed mechanical fasteners.

2.1.1.2 Graphics and Typography

As selected from manufacturer's standards.

2.1.1.3 Colors and Finishes

Match existing MPO standard. Reference sign drawings.

2.1.1.4 ADA Compliance

Sign system shall comply with all applicable provisions of the 2010 Standards for Accessible Design (the updated ADA Accessibility Guidelines, ADAAG), effective in March 2011. This includes requirements regarding which sign types require Braille/tactile features, character heights, raised character spacing, raised character stroke width, color contrast and installation locations / mounting heights within the facility.

2.1.1.5 Materials and Construction

- a. Sign assemblies shall be comprised of an extruded aluminum frame and an inner core rigid enough to properly support the display/insert material. Overall depth of all frames 17"w or less shall not exceed 7/16". Frames must allow for front loading/re-loading of insert panels and must offer an option for a concealed locking method to increase tamper resistance.
- b. Aluminum frame extrusions shall be extruded in the USA.
- c. ADA-compliant components shall be Tactile process direct-print, UV-cured, 1/32" thick tactile characters and fully domed Braille printed on an acrylic or aluminum plaque.
- d. Graphic Inserts/Panels are as per sign drawings and should be easily

updatable without the need to replace the entire sign assembly.

- e. Fasteners: Signs shall be able to accommodate fully concealed mechanical fasteners.

2.1.6 Basic System Description

Basic System Description: Low profile aluminum sign frames with a wide range of graphics inserts and displays. Reference drawings for colors, finishes, type styles and other details. Reference sign schedule for exact messages.

a. Edge Profile Shape

- 1. Square
- 2. Contour

b. Frame Finish

- 1. Natural Satin Anodized
- 2. Painted Finish
 - a) MPO Standard:

c. Core Sign Types: Reference sign type drawings for colors, finishes, sizes and details. Reference signage schedule for graphics/copy specifications

- 1. Sign Type ST - Stair ID Sign .
- 2. Sign Type AR - Area of Refuge ID Sign.
- 3. Sign Type PD Elevator Lobby sign.
- 4. Sign Type WR - Women Restroom ID sign.
- 5. Sign Type MR - Men Restroom ID sign.
- 6. Sign Type RR - Single User Restroom ID sign.
- 7. Sign Type US-1_- User Space Room ID.
- 8. Sign Type US-2_- Secondary User Space Room ID Sign.
- 9. Sign Type RB - Restroom Blade ID Sign.
- 10. Sign Type NM - Mothers Room ID sign.
- 11. Sign Type CR - Conference Room ID sign.
- 12. Sign Type FB - Fire Extinguisher ID Blade Sign.
- 13. Sign Type IDS - Interior Directional sign.
- 14. Sign Type SR - Support Room ID sign.
- 15. Sign Type EX - Tactile Exit sign.
- 16. Sign Type DR -Directory sign.
- 17. Sign Type SRX - Support Room Exterior sign.
- 18. Sign Type STX - Stair Exterior sign.

2.1.7 Graphics / Typography

- a. Type Sizes: Selected from manufacturer's standard sizes indicated in SCHEDULE for particular units; meet ADA requirements for letter proportions and sizes.
- b. Typography: Reference signage schedule and individual signtype drawings for details. Font(s) selected from manufacturer's standards unless otherwise specified. All text and graphics shall be a true representation of the typeface(s) and/or graphics specified. Letter spacing and interline spacing shall be set by the manufacturer.

- 1. Helvetica Neue 65 Medium

- c. Type: Uppercase.
- d. Type: Indicated in SCHEDULES Article.
- e. Imprint Colors: Match existing MPO standard direct-print colors and indicated in SCHEDULE; color contrast background colors in accord with ADA requirements.
- f. Copy/Message List: Indicated in SCHEDULE.
- g. Reference drawings and Signage Schedule for details.
- h. All text and graphics shall be a true representation of typeface(s) and/or graphics specified.

2.2 ROOM IDENTIFICATION SIGN

2.2.1 Sign Faces

Provide sign faces of clear acrylic or PETG plastic with 0.125 inch thickness minimum, with dimensions of sign face being as indicated. Sign faces can be direct printed and contain two window openings for acrylic inserts; include a space for ADA compliant room tactile and Braille. Sign faces may also have approved printed logos for brand recognition.

2.2.2 Frame Sizes

- a. Frame Sizes Selected from Manufacturer's Standards.
- b. Insert/Display Components to Include:
 - 1. 1/8" Thick Non-Glare Acrylic Lens with Subsurface ADO (Digital Output) or Laser-Printed Insert.
 - 2. 1/8" Thick Painted Acrylic Plaque with Direct-Print Graphics
 - 3. 1/8" Thick Acrylic with UV-Cured, Direct-Print Raised Characters & Braille.
 - 4. 1/16" Thick Acrylic ADA Bottom Plaque with UV-Cured, Direct-Print Raised Characters & Braille, with Aluminum Divider
 - 5. 1/8" Thick Acrylic ADA Bottom Plaque with UV-Cured, Direct-Print Raised Characters & Braille, without Aluminum Divider.
 - 6. 1 1/8"h Aluminum Slider Band.
- c. Mounting/Installation Types to Include
 - 1. Surface Wall Mount
 - a) Concealed Mechanical Fasteners (MF)
 - 2. Projection Wall Mount with Aluminum Bracket.

2.2.3 Room Identification Tactile Letters

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.

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 BUILDING DIRECTORIES

Provide building directories as lobby directories or floor directories, with a changeable directory. Provide dimensions, details, and materials of sign and message content as indicated on the drawings.

2.4.1 Doors

2.4.1.1 Door Glazing

Provide door glazing with 1/4 inch thick polished clear glass, fully tempered in accordance with ASTM C1048 and ANSI Z97.1.

2.4.1.2 Door Construction

Provide extruded aluminum door frame of same finish as surrounding frame; mitered corners, and assembled with concealed fasteners. Provide continuous concealed hinges in finish to match frames and trim. Set glazing in frame with clear silicone adhesive.

2.4.1.3 Door Locks

Provide manufacturer's standard door locks; keyed alike. Provide two sets of keys.

2.4.2 Fabrication

Provide extruded aluminum frames and trim with welded corners and mitered to a hairline fit, with no exposed fasteners.

2.4.3 Non-Illuminated Unit

Directory consists of a non-illuminated unit with changeable aluminum insert slots that accept a user-printed cardstock insert. Design of unit as indicated on the drawings.

2.4.3.1 Construction

The directory is 2 3/4 inches deep frame constructed of aluminum with black anodized finish. Unit is surface mounted. Unit has a 3 inch header size and lettering as shown. Unit has a 1 15/32 inch face door frame with concealed hinges and locking system or other secure method. Door frame matches directory material and finish.

2.4.3.2 Message Strips

Message strips are sized in accordance with manufacturer's standard. Provide letters and numbers in accordance with the drawings.

2.5 PRESSURE SENSITIVE LETTERS

2.5.1 Fabrication

Ensure that vinyl letter edges and corners of finished letterforms and graphics are true and clean. Do not use letterforms and graphics with rounded positive or negative corners, nicked, cut, or ragged edges.

2.5.2 Size

Letter size: as indicated.

2.6 MATERIALS

2.6.1 Aluminum Alloy Products

Aluminum extrusions are at least 1/8 inch thick, and aluminum plate or sheet are at least 0.0508 inch thick. Extrusions conform to ASTM B221; plate and sheet conforms to ASTM B209. Where anodic coatings are specified, alloy conforms to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes are as shown. Welding for aluminum products conforms to AWS D1.2/D1.2M.

2.6.2 Organic Coating

Organic coating conforms to AAMA 2604, with total dry film thickness not less than 1.2 mils.

2.6.3 Plastic Laminate Sheet

ANSI/NEMA LD 3, general purpose HGS grade, 0.048 inch nominal thickness.

2.6.4 Fabrication and Manufacture

2.6.4.1 Factory Workmanship

Holes for bolts and screws are drilled or punched. Drilling and punching produces clean, true lines and surfaces. Exposed surfaces of work have a smooth finish; exposed riveting is flush. Conceal fastenings where practicable.

2.6.4.2 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces prevent galvanic or corrosive action.

2.6.5 Typeface

Helvetica Neue 65 Medium.

2.7 GRAPHICS

Provide signage graphics for modular signs to the following:

2.7.1 Subsurface Copy

Copy is transferred to the back face of clear acrylic sheeting forming the panel face to produce precisely formed opaque image. This method bonds

all sign elements (color, graphics, lettering, Braille and substrate) into a single unit.

2.7.2 First Surface Copy Direct Print (Non-Tactile)

Message may be applied to panel using a direct print process. Original art is defined as artwork that is a first generation reproduction of the specified art. Provide clean edges and corners.

2.7.3 Photopolymer

Integral graphics and Braille achieved by photomechanical stratification processes. Provide photopolymer used for ADA compliant graphics of the type that has a minimum durometer reading of 90. Tactile graphics are raised 1/32 inch from the first surface of plaque by photomechanical stratification process.

2.8 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 signage plans. Submit operating instructions outlining the step-by-step procedures required for system operation. The instructions include simplified diagrams for the system as installed, the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Provide each set permanently bound with a hard cover. The following identification must be inscribed on the covers: "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number. Submit in accordance with Section 01 78 23 OPERATING AND MAINTENANCE DATA. Mounting height and mounting location complies with 36 CFR 1191. Install required blocking. Do not install signs on doors or other surfaces until finishes on such surfaces have been installed. Signs installed on glass surfaces are installed with matching blank back-up plates in accordance with manufacturer's instructions.

Do not install items that show visual evidence of biological growth.

3.1.1 Anchorage

Provide anchorage in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown includes slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Provide exposed anchor and fastener materials compatible with metal to which applied with matching color and finish.

- a. Signs mounted to painted gypsum board surfaces must be removable for painting maintenance.

- b. Mount signs to lay-in ceiling grids with clip connections to ceiling tees.
- c. Install signs mounted on metal surfaces with magnetic tape.
- d. Install signs mounted on fabric surfaces with hook and loop tape or pin mount.
- e. Install signs 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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 21 13

TOILET COMPARTMENTS

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 REGULATORY REQUIREMENTS
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 WARRANTY

PART 2 PRODUCTS

- 2.1 SYSTEM REQUIREMENTS
- 2.2 MATERIALS
 - 2.2.1 Stainless Steel Sheet (Finish 2)
 - 2.2.2 Sound-Deadening Cores
 - 2.2.3 Anchoring Devices and Fasteners
 - 2.2.4 Brackets
 - 2.2.5 Hardware and Fittings
 - 2.2.5.1 General Requirements
 - 2.2.5.2 Finishes
 - 2.2.6 Door Hardware
 - 2.2.6.1 Hinges
 - 2.2.6.2 Latch and Pull
 - 2.2.6.3 Coat Hooks
- 2.3 PARTITION PANELS AND DOORS
 - 2.3.1 Toilet Enclosures
 - 2.3.2 Urinal Screens
- 2.4 CEILING-HUNG PARTITIONS
- 2.5 HARDWARE
- 2.6 COLORS AND FINISHES
 - 2.6.1 Colors
 - 2.6.2 Finishes
 - 2.6.2.1 Finishes No. 2

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 METAL PARTITION FABRICATION
- 3.3 INSTALLATION
- 3.4 CEILING-HUNG PARTITIONS
- 3.5 FINAL ADJUSTMENT
- 3.6 CLEANING

-- End of Section Table of Contents --

SECTION 10 21 13

TOILET COMPARTMENTS
08/20

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A385/A385M	(2020) Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A666	(2015) Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM	(2017) Standard And Commentary Accessible and Usable Buildings and Facilities
-----------------	---

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003	(Basic) Partitions, Toilet, Complete
---------------	--------------------------------------

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines
-------------	--

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Fabrication Drawings

Installation Drawings; G

SD-03 Product Data

Cleaning and Maintenance Instructions

Colors And Finishes

Sound-Deadening Cores

Anchoring Devices and Fasteners

Hardware and Fittings

Brackets

Door Hardware

Toilet Enclosures

Urinal Screens

Finishes; G

Recycled content for stainless steel partitions and screens; S

SD-04 Samples

Colors and Finishes; G

Hardware and Fittings

Anchoring Devices and Fasteners

SD-07 Certificates

Warranty

1.3 REGULATORY REQUIREMENTS

Comply with to ICC A117.1 COMM code for access for the handicapped operation of toilet compartment door and hardware.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

1.5 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for a period of one year from date of final acceptance of the work.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

Provide a complete and usable toilet partition system, including toilet enclosures, urinal screens, system of panels, hardware, and support components. Furnish the partition system from a single manufacturer, with a standard product as shown in the most recent catalog data. Submit Fabrication Drawings for toilet partitions and urinal screens consisting of fabrication and assembly details to be performed in the factory. Submit manufacturer's Cleaning and Maintenance Instructions in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.2 MATERIALS

2.2.1 Stainless Steel Sheet (Finish 2)

Provide stainless steel sheet conforming to ASTM A666, 300 series commercial stainless steel sheet suitable for exposed applications with a Flame Spread Index of 0 and a Smoke Developed Index of 0. Provide smooth material, without creases or ripples. Provide face sheet of minimum of 0.048 inch ((18 gauge) thickness. Provide with No. 4 finish. Provide steel with a minimum of 25 percent recycled content.

2.2.2 Sound-Deadening Cores

Provide sound deadening consisting of treated kraft paper honeycomb cores with a cell size of not more than 1 inch. Provide resin-material content weighing not less than 11 percent of the finished core weight. Face expanded cores on both sides with kraft paper.

2.2.3 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

2.2.4 Brackets

Provide two-ear panel wall brackets, T-style, 1 inch stock. Provide stirrup style panel-to-pilaster brackets.

2.2.5 Hardware and Fittings

2.2.5.1 General Requirements

Provide hardware for the toilet partition system that complies with CID A-A-60003 for the specified type and style of partitions. Provide hardware finish highly resistant to alkalis, urine, and other common toilet room acids. Comply with 36 CFR 1191 of latching devices and hinges for handicap compartments; provide stainless steel devices and hinges with door latches that operate without either tight grasping or twisting of the wrist of the operator. Submit three samples of each item, including anchoring devices and fasteners. Approved hardware samples may be installed in the work if properly identified.

2.2.5.2 Finishes

- a. Provide stainless steel with a No. 4 finish.

2.2.6 Door Hardware

2.2.6.1 Hinges

Provide adjustable hinges to hold in-swinging doors open at any angle up to 90 degrees and outswinging doors up to 10 degrees. Provide self-lubricating hinges with the indicated swing. Provide hinges that are surface-mounted type and have the following type of return movement:

- a. Gravity return movement

2.2.6.2 Latch and Pull

Provide latch and pull that is a combination rubber-faced door strike and keeper equipped with emergency access. Provide surface mounted latch.

2.2.6.3 Coat Hooks

Provide coat hooks that are combination units with hooks and rubber tipped pins.

2.3 PARTITION PANELS AND DOORS

Fabricate partition panels, and pilasters of materials and construction listed:

Provide stainless steel partition panels and doors in finished thickness of no less than 1 inch and pilasters no less than 1-1/4 inches, both with face sheets no less than 0.038 inch. .

Provide stainless steel toilet partitions and screens with recycled content of 50 percent minimum. Provide data identifying percentage of recycled content for stainless steel partitions and screens. . . .

2.3.1 Toilet Enclosures

Provide toilet enclosures that comply with CID A-A-60003, Type I, Style B, ceiling hung. Furnish width, length, and height of toilet enclosures as shown. Finish surface of panels are stainless steel (Finish 2); water resistant; graffiti resistant; non-absorbent radius beveled edges. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required, and provide cut outs for through partition toilet accessories. Provide grab bars to withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars cannot rotate within their fittings.

2.3.2 Urinal Screens

Provide urinal screens that comply with CID A-A-60003, Type III, Style F, wall hung. Provide finish for surface of screens as stainless steel (Finish 2); water resistant; graffiti resistant; non-absorbent with radius beveled edges; with manufacturer's standard post design of materials matching the thickness and construction of pilasters. Furnish width and height of urinal screens as shown. Provide thickness to match toilet compartment panel construction. Secure wall hung urinal screens with a minimum of three wall stirrup brackets. Fabricate screens from the same types of panels and pilasters as the toilet partitions. Use corrosion-resistant steel fittings and fasteners.

2.4 CEILING-HUNG PARTITIONS

Provide pilasters in size indicated that are manufacturer's standard corrosion resistant anchoring assemblies complete with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Design anchoring device to transmit the strain and loading on the pilaster directly to the structural support above without putting strain or loading on the finished ceiling. Provide sleeves or caps at tops of pilasters to conceal anchorage.

2.5 HARDWARE

Provide hardware for the toilet partition system that complies with CID A-A-60003 for the specified type and style of partitions. Provide hardware pre-drilled by manufacturer. Use a hardware finish that is highly resistant to alkalis, urine, and other common toilet room acids. Hardware includes: chrome plated nonferrous cast pivot hinges, gravity type, adjustable for door close positioning; nylon bearings; door strike and keeper with rubber bumper; and cast alloy chrome plated coat hook and bumper. Provide latching devices and hinges for handicap compartments complying with 36 CFR 1191 and stainless steel door latches that operate without either tight grasping or twisting of the wrist of the operator. Use stainless steel, tamper proof type screws and bolts. Wall mounting brackets are continuous, full height, stainless steel, in accordance with toilet compartment manufacturer's instructions.

2.6 COLORS AND FINISHES

2.6.1 Colors

Provide manufacturer's standard finish for toilet partition system components, as indicated on the drawings. Submit three samples showing finished edge on two adjacent sides and core construction, each not less than 12 inch square.

2.6.2 Finishes

2.6.2.1 Finishes No. 2

Provide partitions, panels, screen, and door finishes that comply with CID A-A-60003 finished with Finish No. 2, stainless steel. Provide finish texture as indicated on drawings.

PART 3 EXECUTION

3.1 PREPARATION

Take field measurements prior to the preparation of drawing and fabrication to ensure proper fits. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work. Verify correct spacing of plumbing fixtures. Verify correct location of built in framing, anchorage, and bracing. Report in writing to Contracting Officer prevailing conditions that adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 METAL PARTITION FABRICATION

- a. Fabricate metal partition panels, doors, screens, and pilasters required for the project from galvanized-steel face sheets with formed edges. Laminate face sheets via pressure to the sound-deadening core with edges sealed with a continuous locking strip and corners mitered and welded. Ground all welds smooth. Provide concealed reinforcement for installation of hardware, fittings, and accessories. Surface of face sheets must be , free from wave, warp, or buckle.

3.3 INSTALLATION

Do not install items that show visual evidence of biological growth. Install partitions rigid, straight, plumb, and level, with the panels centered between the fixtures. Provide a panel clearance of not more than 1/2 inch and secure the panels to walls and pilasters with continuous full height wall brackets. Locate wall brackets so that holes for wall bolts occur in masonry or tile joints. Secure panels to pilasters with brackets matching the wall brackets. Provide for adjustment due to minor floor variations. Locate head rail joints at pilaster center lines. Install adjacent components for consistency of line and plane. Equip each door with hinges, one door latch, and one coat hook and bumper. Align hardware to uniform clearance at vertical edges of doors.

- a. Secure panels to hollow plastered walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Provide toggle bolts with a load-carrying strength of not less than 600 pounds per anchor.
- b. Secure panels to ceramic tile on hollow plastered walls or hollow concrete-masonry walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Provide toggle bolts with a load-carrying strength of not less than 600 pounds per anchor.
- c. Secure panels to solid masonry or concrete with lead or brass expansion shields designed for use with not less than 1/4-20 screws, with a shield length of not less than 1-1/2 inches. Provide expansion shields with a load-carrying strength of not less than 600 pounds per anchor.
- d. Submit Installation Drawings for toilet partitions, and urinal screens showing plans, elevations, details of construction, hardware, reinforcing and blocking, fittings, mountings and escutcheons. Indicate on drawings the type of partition, location, mounting height, cutouts, and reinforcement required for toilet-room accessories.

3.4 CEILING-HUNG PARTITIONS

Secure pilasters to the structural support above with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level the bottoms of doors with bottoms of pilasters when doors are in a closed position.

3.5 FINAL ADJUSTMENT

After completion of the installation, make final adjustments to the pilaster-leveling devices, door hardware, and other working parts of the partition assembly. Doors have a uniform vertical edge clearance of

approximately 3/16 inch and rest open at approximately 30 degrees when unlatched.

3.6 CLEANING

Clean all surfaces and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 21 23.16

CUBICLE TRACK AND HARDWARE

04/06

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DRAWING REQUIREMENTS
- 1.4 DELIVERY AND STORAGE
- 1.5 QUALITY CONTROL

PART 2 PRODUCTS

- 2.1 CUBICLE TRACK SYSTEM
 - 2.1.1 Extruded Aluminum Tracks
- 2.2 CARRIER UNIT
- 2.3 END STOP AND PULL-OUT
- 2.4 FASTENERS
- 2.5 FINISH

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Installation Details

-- End of Section Table of Contents --

SECTION 10 21 23.16

CUBICLE TRACK AND HARDWARE

04/06

PART 1 GENERAL

1.1 REFERENCES

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

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 B456 (2017) Standard Specification for
Electrodeposited Coatings of Copper Plus
Nickel Plus Chromium and Nickel Plus
Chromium

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

Cubicle Track Layout; G

SD-08 Manufacturer's Instructions

Cubicle Track Installation

SD-10 Operation and Maintenance Data

Cubicle Track System, Data Package 1; ; G

Submit in accordance with Section 01 78 23 OPERATION AND
MAINTENANCE DATA.

1.3 DRAWING REQUIREMENTS

Submit cubicle track layout drawings. Include ceiling, surface-mounted installation details, , and overlay drawing showing other trades

installation within area.

1.4 DELIVERY AND STORAGE

Deliver cubicle tracks to site in unopened containers clearly labeled with manufacturer's name and contents. Store in safe, dry, and clean location. Do not open containers until contents are to be installed.

1.5 QUALITY CONTROL

Allow smooth, rapid, and complete screening with no gaps at corners or ends of track. The track of a standard 8 by 8 foot cubicle shall have no joints. Form corner bends in a single continuous piece on a 12 inch radius to exactly 90 degrees. Other track lengths to 16 feet shall have no joints.

PART 2 PRODUCTS

2.1 CUBICLE TRACK SYSTEM

Heavy-duty type, ceiling surface mounted. Bends shall be minimum 18 inches radius.

2.1.1 Extruded Aluminum Tracks

ASTM B221 and ASTM B456; alloy 6063-TS, channel shape minimum, 1 1/4 inch wide by 1 1/8 inch deep, 0.050 inch minimum wall thickness. Inside raceway to be smooth for interior carriers and must be able to receive a double coated wheel carrier with hook. Finish as designated for aluminum finishes in AA DAF45.

2.2 CARRIER UNIT

Silent type with double canted wheel carrier. Wheels shall have nylon on stainless steel hooks with swivel to support the curtain. Carriers shall be removable only through access aperture or through end-cap that provides room for insertion or removal of carrier. Provide 2.2 carriers for every foot of track length, plus one additional carrier. Provide a safety loading unit at one end of the channel track consisting of a section of channel track equipped with a hinge and end latch to permit lowering for installation of or removal of curtains from hooks without the use of a step-ladder and without removing carriers from track. Rivet moveable end of safety loading unit to be riveted to the hinge. Latching end of safety loading unit with a double locking fail-proof locking device for safety. Safety loading unit to be four feet in length of an 8 foot ceiling installation so latch end lowers to four feet from floor, for installation or removal of curtain without the use of a step-ladder. Increase length of safety loading unit to be increased according to ceiling height. Provide a key wand for every 20 units.

2.3 END STOP AND PULL-OUT

Fabricate from aluminum or nylon with an anodized finish matching the track finish.

2.4 FASTENERS

Stainless steel.

2.5 FINISH

Satin, clear anodized.

PART 3 EXECUTION

3.1 INSTALLATION

Verify dimensions prior to installation. Install cubicle track after painting and finishing operations are complete. Provide labor and all materials indicated, specified or necessary for a complete finished installation. Install track plumb, level and true, and securely anchored to the ceiling to form a neat, rigid installation. Remove damaged or defective components and replace with new components.

3.1.1 Installation Details

Install heavy-duty cubicle tracks ceiling surface mounted. Install cubicle tracks where indicated. Install carrier units at 6 inches on center maximum. Install end cap at each end of the track and pull-out at the end where curtains are stacked to permit insertion and removal of carrier units. Securely fasten end stops to prevent their being forced out by striking weight of carrier units.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 22 39

FOLDING PANEL PARTITIONS

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality Certification
 - 1.3.1.1 Indoor Air Quality for Finish Covering
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Coordination Drawings
 - 1.4.2 Installer Qualifications
 - 1.4.3 Manufacturer's Qualifications
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 WARRANTY
 - 1.6.1 Warranty Periods

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Manual Operation
 - 2.1.2 Performance Requirements
 - 2.1.2.1 Laboratory Acoustical Requirements
- 2.2 MATERIALS
- 2.3 FOLDING PANEL PARTITIONS
 - 2.3.1 Panels
 - 2.3.2 Partition System
 - 2.3.3 Track
 - 2.3.4 Suspension System
- 2.4 ACCESSORIES
 - 2.4.1 Pass Doors
 - 2.4.1.1 Pass Door Hardware
 - 2.4.2 Metal Soffit
 - 2.4.3 Markerboards
- 2.5 SEALS AND SWEEPSTRIPS
- 2.6 COLOR
 - 2.6.1 Sample Size

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Preparation Work
 - 3.1.2 Adjustment
- 3.2 FIELD TESTS
 - 3.2.1 Operational Test
 - 3.2.2 Visual Test
 - 3.2.3 Acoustical Test
 - 3.2.3.1 Sub Title

3.3 CLEANING

-- End of Section Table of Contents --

SECTION 10 22 39

FOLDING PANEL PARTITIONS

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 A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM D751	(2006; R 2011) Coated Fabrics
ASTM E90	(2009; R2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E336	(2020) Standard Test Method for Measurement of Airborne Sound Attenuation between Rooms in Buildings
ASTM E413	(2016) Classification for Rating Sound Insulation
ASTM E557	(2012; R 2020) Standard Guide for Architectural Design and Installation Practices for Sound Isolation between Spaces Separated by Operable Partitions

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
--------------------	--

CHEMICAL FABRICS AND FILM ASSOCIATION (CFFA)

CFFA-W-101-D	(2002) Quality Standard for Vinyl Coated Fabric Wallcovering
--------------	--

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 286 (2019) Standard Methods of Fire Tests for
Evaluating Contribution of Wall and
Ceiling Interior Finish to Room Fire Growth

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

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

Coordination Drawings; G
Layouts; G

Installation Drawings; G

SD-03 Product Data

Folding Panel Partitions; G

Recycled Content for Steel Components; S

Recycled Content for Aluminum Components; S

SD-04 Samples

Partition System Samples; G

SD-06 Test Reports

Acoustical Test Reports; G

Field Sound Test Reports

SD-07 Certificates

Indoor Air Quality for Finish Covering; S

Installer Qualifications

Manufacturer's Qualifications

SD-08 Manufacturer's Instructions

Installation Instructions

SD-10 Operation and Maintenance Data

Folding Panel Partitions, Data Package 1 and 2; G

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality Certification

1.3.1.1 Indoor Air Quality for Finish Covering

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 QUALITY ASSURANCE

1.4.1 Coordination Drawings

Provide reflected ceiling plans, applicable details and other drawings as required to suit conditions, drawn to scale, for the following coordinated items, using input from adjacent materials/systems installers, field measurements and verification of conditions:

- a. Partition track, track supports and seismic bracing, switches, turning space, and storage layout.
- b. Suspended ceiling system components and structural members used for attachment.
- c. Items penetrating finished ceiling in vicinity of folding panel partition location.
- d. Accessories located within the folding panel partitions.

1.4.2 Installer Qualifications

Installer must have a minimum of 5 years of documented successful experience in the installation of folding panel partitions. When required by manufacturer, folding panel partitions must be installed by an authorized dealer with a certified crew.

1.4.3 Manufacturer's Qualifications

Manufacturer must have a minimum of 10 years of documented successful experience in designing and manufacturing folding panel partitions conforming to the requirements specified in this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the jobsite in the manufacturer's original, unopened, and undamaged packages with labels legible and intact. Provide labels to indicate the manufacturer, brand name, size, finish, and placement

location. Store partitions and accessories in unopened packages in a manner to prevent damage. Handle partition materials in accordance with manufacturer's instructions. Protect materials from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship for specified warranty periods from date of final acceptance of the work as follows:

1.6.1 Warranty Periods

- a. Structural: 5 years
- b. Plastic and Wood Materials: 2
- c. Fabric Materials: 2 years

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide manual operation, acoustical folding panel partitions, factory finished, supported from overhead track without floor gliders, as shown on the drawings including all hardware, seals, track and rollers as needed to close the specified opening.

Submit detail coordination drawings and installation drawings of each folding panel partition 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 folding panel partition indicated. Include manufacturers' literature, finishes, profiles and thicknesses of materials.

Submit manufacturers' operations and maintenance data for each type of folding panel partition in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

2.1.1 Manual Operation

Manual operation must be a force no greater than 20 lbf to start movement at the rate of 3.33 ft/s (200 ft/min). Use a removable handle to extend and retract the bottom operable seals; vertical movement of seals must be 2 inches. Provide closure to the lead wall with the use of a flexible bulb; accomplish final closing by means of a lever exerting pressure against the wall.

2.1.2 Performance Requirements

2.1.2.1 Laboratory Acoustical Requirements

Provide partitions tested in accordance with ASTM E90, by a laboratory accredited by the U.S. Bureau of Standards, that have attained a sound transmission class (STC) of not less than 50 in a fully extended position, with a Noise Reduction Coefficient (NRC) of 0.25-0.30 for napped, tufted or looped fabric. Provide documentation that the partition tested is the same construction, materials, and model number as the partition to be

provided and be fully operable. Test specimen is not less than 126 square feet in area, (14 feet by 9 feet). Provide a minimum panel weight of 5.5 per square foot for STC up to 40, 7.5 psf for STC up to 45, 8.5 per square foot for STC up to 50, and 10.0 per square foot for STC up to 53. Design panel thickness (3 inch nominal) and composition to provide the required STC rating in accordance with ASTM E90 and ASTM E413. Submit acoustical test reports in accordance with ASTM E90, ASTM C423 and ASTM E413.

2.2 MATERIALS

Provide heavy-duty type hardware standard with the manufacturer. Provide pulls and latches for all partitions. Provide partitions with privacy latches. Provide manufacturer's standard finish hardware. Provide horizontal and vertical trim painted off white with matching rubber.

2.3 FOLDING PANEL PARTITIONS

Provide folding panel partitions using top hung ball bearing carriers which support modular panels.

- a. Provide partitions made up of a series of rigid panels, each panel being a one-piece assembly. Unless otherwise specified, use the least number of panels. The mechanical seal of the panel must actuate with a single operating action.
- b. Provide single (omni directional) type panels as indicated.

2.3.1 Panels

Provide panels of steel skin fiberboard laminated to appropriate structural acoustical backing, mounted in full perimeter protective frame. Steel for the panel frames must be manufacturer's standard. Frame must enclose and protect all edges of the surface material. Provide panels as indicated, except for end closure panels, and full height to track. Panels must lock in place to form a stable, rigid partition; low profile hinges may not project more than 1/4 inch maximum from panel edge. Panel surfacing must wrap around the vertical panel edges without vertical trim.

Provide steel components that contain a minimum of 10 percent recycled content. Provide data identifying percentage of recycled content for steel components.

Provide aluminum components that contain a minimum of 30 percent recycled content. Provide data identifying percentage of recycled content for aluminum components.

2.3.2 Partition System

Provide finish covering material minimum width and type as indicated on drawings, in accordance with CFFA-W-101-D, and conforming to ASTM D751 and NFPA 286. Provide acrylic backed fabric of 100 percent polyester. Provide non-allergenic stain and mildew resistant fabric that does not rot or support growth of bacteria. Provide finish covering that meets emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type). Provide certification of indoor air quality for finish covering.

2.3.3 Track

Provide recess enamel finish steel track as shown. Provide steel that conforms to ASTM A653/A653M. Provide track that is the manufacturer's standard product designed for the weight of the finished partition, including door. Provide track sections in the maximum lengths practicable, and not less than 6 feet long except for narrow doors and at ends of runs where short length and "drop-out service" sections of track are required. Provide suitable joint devices such as interlocking keys at each joint to provide permanent alignment of track.

2.3.4 Suspension System

Provide a suspension system consisting of steel track connected to the structural support by threaded rods, and trolleys designed to support the weight of the partition. Provide steel track of 7 gauge minimum, phosphate treated or painted. Provide center hung panel with 1 trolley with four ball bearing nylon or steel tired wheels per panel.

2.4 ACCESSORIES

2.4.1 Pass Doors

Provide ADA/ABA compliant pass door of the same materials, construction, acoustical qualities, finish and thickness as the basic panels. Pass door panel legs require bottom thresholds. Provide pass door leaf with perimeter trim to protect face finish and to provide visual identification as required by International Building Code. Pass door leaf incorporates a self-adjusting retractable bottom seal providing sound control when door is closed. Hinges finished to match other exposed hardware.

2.4.1.1 Pass Door Hardware

- a. Mechanically operated floor seal on panels containing pass doors.
- b. Concealed door closer.
- c. Latchset: Passage set.
- d. Exit Sign: Passive screen printed. .

2.4.2 Metal Soffit

Provide soffit when steel. Provide metal soffit of adequate thickness to protect the ceiling from damage by door operation and with the door manufacturer's standard neutral-color applied finish. Provide soffit on aluminum track that is an integral part of the track.

2.4.3 Markerboards

Provide markerboards with steel frame with writing surface of cast acrylic plastic with color fused to surface. Markerboard must be flush. Color: white.

2.5 SEALS AND SWEEPSTRIPS

Provide perimeter seals or sound insulation, of manufacturer's standard product, to achieve the sound transmission class specified and to pass the visual field test specified, without crack or craze when subjected to

severe usage. Provide mechanical bottom seal that can be raised or lowered for positive control. Provide manufacturer's vertical seals between panels to ensure acoustical rating. Bottom seals consist of a vinyl sweep mechanical seal which expands in place, or provide panels which can be lowered by a removable operating device. Provide vertical seal between panels which is anodized, architectural grade, aluminum extrusion with vinyl sound seal. Sweep strips must be vinyl or other material that will not crack or craze with severe usage. Provide sweep strip STC to the specified rating.

2.6 COLOR

Provide partition system samples in sizes indicated below and colors as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

2.6.1 Sample Size

- a. Textile Facing Material: Full width by not less than 36 inches long.
- b. Panel Facing Material: Manufacturer's standard size, not less than 6 inches square.
- c. Panel Edge and Chair Rail Materials: Manufacturer's standard size, not less than 6 inches long.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth. Install in accordance with the approved installation drawings and the manufacturer's written installation instructions.

3.1.1 Preparation Work

Verify dimensions and condition of openings scheduled to receive folding panel partitions. Install partitions in accordance with the approved partition layouts, manufacturer's directions, and ASTM E557. Provide structural support for the track support elements as indicated.

3.1.2 Adjustment

Adjust manually operated partitions to open and close from any position with a maximum horizontal force as specified in paragraph MANUAL OPERATION applied to pendant pull, box or handle.

3.2 FIELD TESTS

3.2.1 Operational Test

In the presence of the Contracting Officer, operate partition at least three times to demonstrate that partition is capable of being moved from the stored position to the fully extended position smoothly and quietly and without overloading the drive components. Activate the emergency release mechanism and demonstrate proper operation of the partition in the manual mode and activate mechanical seals top and bottom. Adjust partitions which do not operate properly and retest.

3.2.2 Visual Test

Conduct visual field tests for light leakage with all room lights turned on in the space on one side of the partition. Darken space on the other side of the partition. Light leakage from the lighted space to the darkened space is not acceptable. If light leakage does occur, adjust the partition to correct the problem and retest.

3.2.3 Acoustical Test

3.2.3.1 Sub Title

Provide partition testing by an independent certified acoustical consultant in accordance with ASTM E336, and achieve a Noise Isolation Class (NIC) of as indicated plus or minus two. Adjust and/or modify partitions which do not comply, and retest. Submit field sound test reports.

3.3 CLEANING

Clean any soiled parts of the partition in accordance with manufacturer's written instructions.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 26 00

WALL AND DOOR PROTECTION

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Indoor Air Quality
 - 1.3.1.1 Wall Covering and Panels
 - 1.3.1.2 Adhesives and Sealants
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 WARRANTY

PART 2 PRODUCTS

- 2.1 STANDARD PRODUCTS
 - 2.1.1 Resilient Material
 - 2.1.1.1 Minimum Impact Resistance
 - 2.1.1.2 Fire Resistance Rating
 - 2.1.1.3 Integral Color
 - 2.1.1.4 Chemical and Stain Resistance
 - 2.1.1.5 Fungal and Bacterial Resistance
- 2.2 CORNER GUARDS
 - 2.2.1 Resilient Corner Guards
- 2.3 FINISH
 - 2.3.1 Resilient Material Finish
- 2.4 ADHESIVES
- 2.5 COLOR

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Corner Guards and Wall Guards

-- End of Section Table of Contents --

SECTION 10 26 00

WALL AND DOOR PROTECTION

08/20

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
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 F476	(2014) Standard Test Methods for Security of Swinging Door Assemblies
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 2014) 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 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

Corner Guards; G

SD-03 Product Data

Corner Guards; G

Recycled content for aluminum component of corner guards; S

SD-04 Samples

Corner Guards; G

SD-06 Test Reports

Fire Resistance Rating

SD-07 Certificates

Indoor air quality for adhesives and sealants; S

SD-10 Operation and Maintenance Data

Corner Guards, Data Package 1; G

1.3 CERTIFICATIONS

1.3.1 Indoor Air Quality

1.3.1.1 Wall Covering and Panels

Provide sheet and high impact resistant resilient materials 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.

1.3.1.2 Adhesives and Sealants

Provide adhesives and sealants certified to meet California Department of Public Health (CDPH) Standard Method, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold and VOC content requirements of SCAQMD Rule 1168. Submit product data for indoor air quality for adhesives and sealants.

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 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 PVC free acrylic vinyl conforming to the following:

2.1.1.1 Minimum Impact Resistance

Minimum impact resistance must be 49.62 ft-lbs/sq. inch when tested in accordance with ASTM F476.

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 surface mounted corner guards, radius formed to profile shown. Provide corner guards that extend from floor to ceiling. Furnish mounting hardware, cushions, and base plates. Provide assembly consisting of a snap-on corner guard formed from high impact resistant resilient material, mounted on a continuous aluminum retainer. Extruded aluminum retainer conforms to ASTM B221, alloy 6063, temper T5 or T6. Provide aluminum components that contain a minimum of 35 percent recycled content. Provide data identifying percentage of recycled content for aluminum component of corner guards. Flush mounted type guards act as a stop for adjacent wall finish material. 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 FINISH

Submit samples indicating color and texture of materials requiring color and finish.

2.3.1 Resilient Material Finish

Provide resilient material finish of embossed texture with colors in accordance with SAE J1545.

2.4 ADHESIVES

Provide adhesive for resilient material in accordance with manufacturers recommendations. Provide sealants and non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350

(limit requirements for either office or classroom spaces regardless of space type) the VOC content requirements of SCAQMD Rule 1168, or VOC content requirements of GS-36. Provide certification of indoor air quality for adhesives.

2.5 COLOR

Provide color as indicated; 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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 28 13

TOILET ACCESSORIES

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING
- 1.4 WARRANTY

PART 2 PRODUCTS

- 2.1 ACCESSORY ITEMS
 - 2.1.1 Anchors and Fasteners
 - 2.1.2 Finishes
 - 2.1.3 Item A5080 Dispenser, Paper Towel, SS, Surface Mounted
 - 2.1.4 Item A5083 Dispenser, Paper Towel, Recessed
 - 2.1.5 Item A5084 Dryer, Hands Free, Forced Air, Automatic
 - 2.1.6 Item A5085 Waste Receptacle, Paper Towel, Recessed
 - 2.1.7 Item A5090 Disposal, Sanitary Napkin, SS, Surface Mounted
 - 2.1.8 Item A5091 Disposal, Sanitary Napkin, SS, Partition Mounted, Shared
 - 2.1.9 Item A5095 Sanitary-Napkin and Tampon Vendor, SS, Surface Mounted
 - 2.1.10 Item A5110 Grab Bar, 1-1/4 Inch Diameter, SS, 2 Wall, Shower Use
 - 2.1.11 Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mounted
 - 2.1.12 Item A5145 Hook, Garment, Double, SS, Surface Mounted
 - 2.1.13 Item A5176 Liquid Soap Dispenser, SS, Wall Mounted
 - 2.1.14 Item A5177 Liquid Soap Dispenser, SS, Counter Mounted
 - 2.1.15 Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mounted
 - 2.1.16 Item A5201 Dispenser, Toilet Tissue, SS, 2-Roll, Partition Mounted Shared
 - 2.1.17 Seat Cover Dispenser

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Recessed Accessories
 - 3.1.2 Surface Mounted Accessories
- 3.2 CLEANING

-- End of Section Table of Contents --

SECTION 10 28 13

TOILET ACCESSORIES
08/20

PART 1 GENERAL

1.1 REFERENCES

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

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 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

Product Schedule; G

Submit product Schedule indicating types, quantities, sizes, and installation locations by room for each toilet accessory item required. Identify locations using room designations indicated on the drawings.

SD-03 Product Data

Item A5080 Dispenser, Paper Towel, SS, Surface Mounted; G

Item A5083 Dispenser, Paper Towel, Recessed; G

Item A5084 Dryer, Hands Free, Forced Air, Automatic; G

Item A5085 Waste Receptacle, Paper Towel, Recessed ; G

Item A5090 Disposal, Sanitary Napkin, SS, Surface Mounted; G

Item A5091 Disposal, Sanitary Napkin, SS, Partition Mounted,
Shared; G

Item A5095 Sanitary-Napkin and Tampon Vendor ; G

Item A5110 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, Shower Use; G

Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mntd; G

Item A5145 Hook, Garment, Double, SS, Surface Mounted; G

Item A5176 Liquid Soap Dispenser, SS, Wall Mounted; G

Item A5177 Liquid Soap Dispenser, SS, Counter Mounted; G

Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mntd; G

Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Partition Mounted, Shared; G

Item A5201 Dispenser, Toilet Tissue, SS, 2-Roll, Partition Mounted Shared

Recycled content for stainless steel toilet accessories; S

Seat cover dispenser

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 A5110 Grab Bar, 1-1/4 inch Dia., SS, 2 Wall, Shower Use; G

Item A5080 Dispenser, Paper Towel, SS, Surface Mounted; G

Item A5083 Dispenser, Paper Towel, Recessed; G

Item A5084 Dryer, Hands Free, Forced Air, Automatic; G

Item A5085 Waste Recepticle, Paper Towel, Recessed; G

Item A5090 Disposal, Sanitary Napkin, SS, Surface Mounted; G

Item A5091 Disposal, Sanitary Napkin, SS, Partition Mounted, Shared; G

Item A5095 Sanitary-Napkin and Tampon Vendor; G

Item A5135 Shelf, Utility W/ Mop/Broom Holders, SS, Surf Mntd; G

Item A5145 Hook, Garment, Double, SS, Surface Mounted; G

Item A5176 Liquid Soap Dispenser, SS, Wall Mounted; G

Item A5177 Liquid Soap Dispenser, SS, Counter Mounted; G

Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Surface Mntd; G

Item A5200 Dispenser, Toilet Tissue, SS, 2-Roll, Partition Mounted, Shared; G

Item A5201 Dispenser, Toilet Tissue, SS, 2-Roll, Partition Mounted Shared

Seat cover dispenser

Submit Data Package 1 for each toilet accessory item , and Data Package 2 for each electrical toilet accessory item, in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

1.3 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 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 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.

2.1.4 Item A5083 Dispenser, Paper Towel, Recessed

Recess mounted paper towel dispenser. Unit constructed of heavy gauge stainless steel with satin finish, all welded construction, have full length piano hinge and tumbler lock. Unit dispenses 300 C-fold or 400 multifold paper towels and be self-feeding until supply is depleted. Towel dispensing slot is snag-free. Unit is ADA compliant.

Approximate size: 12 inches wide by 17 inches high by 4 inches deep.

2.1.5 Item A5084 Dryer, Hands Free, Forced Air, Automatic

Surface mounted high speed automatic hand dryer. Unit made of stainless steel with satin finish. Electronic sensor automatically turns dryer on when hands are held under the air outlet opening and cuts off when hands are removed, or after approximately 1-1/2 minutes after dryer turns on. Motor is 5/8 HP. Heating element raises the air temperature to approximately 135 degrees and be vandal proof. Unit meets UL requirements.

Unit requires individual 15 amp circuit.

2.1.6 Item A5085 Waste Receptacle, Paper Towel, Recessed

Recessed satin-finish stainless steel with all-welded construction. Flush locks. Door is secured to cabinet with a concealed, full-length stainless steel piano-hinge, cable door-swing limiter and equipped with two tumbler locks keyed like other Bobrick washroom accessories. Removable, leak-proof waste bin with a capacity of 12-gal (45.5-L)

Approximate size: 15 3/4 inches wide by 8 inches deep by 38 1/2 inches high.

2.1.7 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.

2.1.8 Item A5091 Disposal, Sanitary Napkin, SS, Partition Mounted, Shared

Partition mounted shared 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 attached thru wall of shared toilet partition.

Approximate size: 7 inches wide by 4 inches deep by 10 inches high.

2.1.9 Item A5095 Sanitary-Napkin and Tampon Vendor, SS, Surface Mounted

Surface mounted sanitary napkin and tampon dispenser. Unit made of stainless steel, ASTM A480/A480M No. 4 satin finish and all welded construction. Capacity for 30 tampons and 20 napkins. No coin push button operation. Unit must be attached to wall.

Approximate size: 13 7/8 inches wide by 4 inches deep by 28 inches high.

2.1.10 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 Heliar 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.

2.1.11 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.

2.1.12 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.

2.1.13 Item A5176 Liquid Soap Dispenser, SS, Wall Mounted

Satin-finish stainless steel. Door: 90° return, conceals flange. Vessel on back of door swings open for filling. Hinge and tumbler lock secure door to cabinet. Capacity: 45-fl oz. Valve dispenses all-purpose soaps. Soap refill window. Rough Wall Opening: 8 3/8" W, 4 3/8" H, 3 7/8" min. depth.

Approximate size: 7 inches wide by 5 inches high by 2-3/4 inches deep.

2.1.14 Item A5177 Liquid Soap Dispenser, SS, Counter Mounted

Top-filling counter-mounted foaming soap dispenser equipped with integrated funnel to facilitate ease of maintenance and labor savings. Vandal-resistant locking cover and spout. Corrosion resistant. Bright-polished spout, cover and escutcheon. High-impact-resistant ABS body and shank. Shatter-resistant polyethylene container, 34-fl oz spout length 4 inches).

Approximate size: 7 inches wide by 5 inches high by 2-3/4 inches deep.

2.1.15 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.

2.1.16 Item A5201 Dispenser, Toilet Tissue, SS, 2-Roll, Partition Mounted Shared

Satin-finish stainless steel. Mounts centered through toilet partitions, 1/2"-2" (12-50mm) thick; used from both sides. Holds four standard core toilet tissue rolls up to 5 1/8" (130mm) diameter; two for each side. Chrome-plated plastic spindles with heavy-duty internal springs.

Approximate size: 11 1/2 inches wide by 10 7/8 inches high.

2.1.17 Seat Cover Dispenser

- a. Mounting: Partition mounted and wall-mounted.
- b. Minimum Capacity: 250 seat covers.
- c. Exposed Material and Finish: Stainless steel, ASTM A480/A480M No. 4 finish (satin).
- d. Lockset: Tumbler type.

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. After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.2 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with corrosion-resistant fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on

gypsum board and plaster walls without solid backing into the metal or wood studs, or to backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do not use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 44 16

FIRE EXTINGUISHERS

11/19

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING
 - 1.3.1 Samples
- 1.4 WARRANTY
- 1.5 PROJECT SCHEDULE

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Types
 - 2.1.2 Material
 - 2.1.3 Size
 - 2.1.4 Accessories
- 2.2 EQUIPMENT
 - 2.2.1 Cabinets
 - 2.2.1.1 Material
 - 2.2.1.2 Type
 - 2.2.1.3 Size
 - 2.2.2 Wall Brackets
 - 2.2.2.1 Identification

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 PROTECTION
 - 3.2.1 Repairing
 - 3.2.2 Cleaning

-- End of Section Table of Contents --

SECTION 10 44 16

FIRE EXTINGUISHERS
11/19

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E814 (2013a; R 2017) Standard Test Method for
Fire Tests of Penetration Firestop Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1 (2021) Fire Code

NFPA 10 (2018; ERTA 1-2 2018) Standard for
Portable Fire Extinguishers

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 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

Fire Extinguishers; G

Accessories; G

Cabinets; G

Wall Brackets; G

Schedule; G

SD-03 Product Data

Fire Extinguishers; G

Accessories; G

Cabinets; G

Wall Brackets; G

Replacement Parts List; G

SD-04 Samples

Equipment Samples; G

SD-07 Certificates

Fire Extinguishers Certifications; G

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.

1.3.1 Samples

Provide the following equipment samples: 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:
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 and NFPA 101.

PROVIDE DRY CHEMICAL TYPE FIRE EXTINGUISHER COMPLIANT WITH UL299. PROVIDE CARBON DIOXIDE TYPE FIRE EXTINGUISHERS COMPLIANT WITH UL 154.

2.1.2 Material

Provide enameled steel extinguisher shell.

2.1.3 Size

10 pounds extinguishers.

2.1.4 Accessories

Forged brass valve

Fusible plug

Safety release

Pressure gage

2.2 EQUIPMENT

2.2.1 Cabinets

2.2.1.1 Material

Provide aluminum cabinets.

2.2.1.2 Type

Provide surface type cabinets.

Provide semi-recessed cabinet for a 4 inch wall.

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 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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 10 - SPECIALTIES

SECTION 10 51 13

METAL LOCKERS

05/11

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, HANDLING, AND STORAGE
- 1.4 FIELD MEASUREMENTS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Color Chips

PART 2 PRODUCTS

- 2.1 TYPES
 - 2.1.1 Small Item Lockers
- 2.2 MATERIAL
 - 2.2.1 Aluminum Sheet
 - 2.2.2 Finish
 - 2.2.2.1 Color
- 2.3 COMPONENTS
 - 2.3.1 Built-In Locks
 - 2.3.2 Doors
 - 2.3.2.1 Hinges
 - 2.3.2.2 Latching Mechanisms
 - 2.3.3 Latch Strikes
 - 2.3.4 Silencers
 - 2.3.5 Back and Side Panels, Tops, and Bottoms
 - 2.3.6 Fastening Devices

PART 3 EXECUTION

- 3.1 ASSEMBLY AND INSTALLATION
- 3.2 NUMBERING SYSTEM
- 3.3 FIELD QUALITY CONTROL
 - 3.3.1 Testing
 - 3.3.2 Repairing
 - 3.3.3 Cleaning

-- End of Section Table of Contents --

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 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)

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 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

Types; G

Location; G

Installation; G

Numbering system

SD-03 Product Data

Material; G

Locking Devices; G

Finish; G

Locker components; G

Assembly instructions; G

SD-04 Samples

Color chips; G

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 scheduled.

Government may request performance-characteristic tests on assembled lockers. Tests and results must conform to FS AA-L-00486. Lockers not conforming will be rejected.

PART 2 PRODUCTS

2.1 TYPES

Locker must have the following type and size in the location and quantities indicated. Locker finish colors will be as scheduled.

2.1.1 Small Item Lockers

Cell phone lockers must be as follows:

1: Recessed Mounted Small Item Lockers 35 individual lockers (34 Usable) with Transient Keyed locks.

- a. Heavy duty aluminum compartment and door construction.
- b. One compartment is required for a panel lock (included) and cannot be used for storage. Front access panel swings on a continuous hinge.
- c. Seven (7) doors high and four (5) doors wide with standard "A" size doors (6-1/2" W x 5-1/4" H) with 8-3/4" deep compartments.
- d. Rough opening for recessed mounted units is 1" less than the unit's width, 1" less than the unit's height and equal to the unit's depth.
- e. Fits into a rough opening and secured with mounting hardware (not included) through the back or side panels. Units include a fully integrated flanged collar which fits over the rough opening.

- f. Equip each locker door with a 2" W x 5/8" H clear plastic cardholder (card included) to identify the compartment.
- g. Locker doors are spring latched with resettable combination locks. Master control key allow access to all compartments with a master control key.
- h. Resettable combination locks can be set to a fixed combination or a combination that can be reset after each use. A master control key is available for resettable combination locks that will override the combination and open the locks.

2.2 MATERIAL

2.2.1 Aluminum Sheet

ASTM B221M, ASTM B221M, ASTM B221 for extrusions. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2.2 Finish

Manufacturer's standard epoxy-polyester powder coat.

2.2.2.1 Color

As selected by COR from Manufacturer's full range.

2.3 COMPONENTS

2.3.1 Built-In Locks

FS AA-L-00486. Provide locking devices as built-in combination locks..

2.3.2 Doors

FS AA-L-00486, not less than 0.0598 inch thick aluminum sheet.

2.3.2.1 Hinges

In addition to the requirements of FS AA-L-00486, provide full height piano hinge. Fabricate knuckle hinges from not less than 0.0787 inch thick aluminum sheet. Weld or bolt hinges to the door frame. Weld, bolt, or rivet hinges to the door.

2.3.2.2 Latching Mechanisms

FS AA-L-00486.

2.3.3 Latch Strikes

FS AA-L-00486. Fabricate from not less than 0.0787 inch thick aluminum sheet, except latch strike may be continuous from top to bottom and fabricated as part of the door framing.

2.3.4 Silencers

FS AA-L-00486.

2.3.5 Back and Side Panels, Tops, and Bottoms

FS AA-L-00486, not less than 0.0474 inch thick aluminum sheet.

2.3.6 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 and base with screws as indicated or rivets if manufacturer's standard. 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 as indicated.

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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 12 - FURNISHINGS

SECTION 12 24 13

ROLLER WINDOW SHADES

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATES
 - 1.3.1 Indoor Air Quality Certifications
 - 1.3.1.1 Roller Window Shades
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Qualifications
 - 1.4.1.1 Installer's Qualifications
 - 1.4.2 Flammability Requirements
 - 1.4.3 Electrical Requirements
 - 1.4.4 Anti-Microbial Requirements
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 WINDOW SHADES
 - 2.1.1 Manufacturer's Qualifications
 - 2.1.2 Manually Operated Shades with Single Rollers
 - 2.1.2.1 Chain-and-Clutch Operating Mechanisms
 - 2.1.2.2 Bead Chains
 - 2.1.2.3 Rollers
 - 2.1.2.4 Mounting Hardware
 - 2.1.2.5 Shade Cloth
 - 2.1.2.6 Installation Accessories
 - 2.1.2.7 Room Darkening Shades
 - 2.1.3 Manually Operated Shades with Dual Rollers
 - 2.1.3.1 Chain-and-Clutch Operating Mechanisms
 - 2.1.3.2 Bead Chains
 - 2.1.3.3 Rollers
 - 2.1.3.4 Mounting Hardware
 - 2.1.3.5 Inside Shade Cloth
 - 2.1.3.6 Outside Shade Cloth
 - 2.1.3.7 Installation Accessories
- 2.2 COLOR

PART 3 EXECUTION

- 3.1 FIELD MEASUREMENTS
- 3.2 INSTALLATION
- 3.3 CLEAN-UP

-- End of Section Table of Contents --

SECTION 12 24 13

ROLLER WINDOW SHADES
08/20

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/WCMA A100.1 (2018) American National Standard for
Safety of Window Covering Products

ASTM INTERNATIONAL (ASTM)

ASTM G21 (2015; R 2021; E 2021) Standard Practice
for Determining Resistance of Synthetic
Polymeric Materials to Fungi

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 701 (2019) Standard Methods of Fire Tests for
Flame Propagation of Textiles and Films

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

UNDERWRITERS LABORATORIES (UL)

UL 325 (2017; Reprint Feb 2020) UL Standard for
Safety Door, Drapery, Gate, Louver, and
Window Operators and Systems

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

Detailed Drawings; G

Location Schedule; G

SD-03 Product Data

Window Shades; G, AE

Recycled Content for various fiber components; S

SD-04 Samples

Window Shades; G, AE

SD-06 Test Reports

Flammability Requirements; G

SD-07 Certificates

Indoor Air Quality for roller window shades; S

Qualifications

SD-10 Operation and Maintenance Data

Window Shades, Data Package 1

SD-11 Closeout Submittals

Submit Data Package 1 for roller window shades, and Data Package 2 for electrical operators, in accordance with Section 01 78 23 OPERATIONS AND MAINTENANCE DATA.

1.3 CERTIFICATES

1.3.1 Indoor Air Quality Certifications

1.3.1.1 Roller Window Shades

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide validation by other third-party program that products meet the requirements of this paragraph. Provide current product certification documentation from certification body.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Installer's Qualifications

Installer trained and certified by the manufacturer with a minimum of ten years of experience in installing products comparable to those specified in this section.

1.4.2 Flammability Requirements

Passes in accordance with NFPA 701 small and large-scale vertical burn. Materials tested are identical to products proposed for use.

1.4.3 Electrical Requirements

NFPA Article 100 listed and labeled in accordance with UL 325 or other testing agency acceptable to authorities having jurisdiction, marked for intended use, and tested as a system. Individual testing of components is not acceptable in lieu of system testing.

1.4.4 Anti-Microbial Requirements

'No Growth' per ASTM G21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated and free from dust, water, or other contaminants and has easy access for inspection and handling. Store materials flat in a clean dry area with temperature maintained above 50 degrees F. Do not open containers until needed for installation unless verification inspection is required. Handle and store shades in accordance with manufacturer's recommendations.

1.6 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 WINDOW SHADES

Submit drawings showing plans, elevations, sections, product details, installation details, operational clearances, wiring diagrams and relationship to work. Submit a location schedule showing location, size and quantity of shades. Include the use of same room designations as indicated on the drawings.

Provide product data composed of catalog cuts, brochures, and operating and maintenance instructions on each product to be used. Include styles, profiles and features.

Furnish samples of each type and color of roller shade fabric and roller shade channel. Provide shade material minimum 6 by 6 inches in size. Mark face of material to indicate interior faces.

Mock up: Install shade in area designated by Contracting Officer. Do not proceed with remaining work until the Contracting Officer approves workmanship and operation. Rework mock up as required to produce acceptable work. The approved shade can be used in the installation.

Submit fire resistance data, flame spread and smoke contribution data.

Provide roller tube that operates smoothly and of sufficient diameter and thickness to prevent excessive deflection. Provide brackets that are appropriate for inside mount. Provide shade cloth meeting the performance described in NFPA 701, small scale test. Treat steel features for corrosion resistance.

Provide Various Fiber Components with a minimum of 60 percent recycled content. Provide data identifying percentage of recycled content for various fiber components.

Provide certification of indoor air quality for roller window shades.

2.1.1.1 Manufacturer's Qualifications

Obtain motor-controlled roller shades through one source from a single manufacturer with a minimum of twenty years of experience and minimum of three projects of similar scope and size in manufacturing products comparable to those specified in this section. Furnish manual and motorized shades produced by the same manufacturer to provide matching appearance.

2.1.1.2 Manually Operated Shades with Single Rollers

2.1.1.2.1 Chain-and-Clutch Operating Mechanisms

Provide continuous-loop bead chain and clutch that stops shade movement when bead chain is released; shade to be permanently adjusted and lubricated.

2.1.1.2.2 Bead Chains

Provide bead chain from #10 stainless steel rated to 90 lb. minimum breaking strength with pull chain tensioning device complying with ANSI/WCMA A100.1

- a. Loop Length: Full length of roller shade.
- b. Limit Stops: Allows shade to stop when chain is released. Provide limit stops to prevent shade from being raised or lowered too far.
- c. Chain-Retainer Type: Clip, jamb mount.

2.1.1.2.3 Rollers

Provide corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shade bands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shade cloth for service.

- a. Roller Drive-End Location: Right side of interior face of shade.
- b. Direction of Shade cloth Roll: Regular, from back (exterior face) of roller.
- c. Shade cloth-to-Roller Attachment: Manufacturer's standard method. Adhesive attachment is not acceptable.

2.1.1.2.4 Mounting Hardware

Provide corrosion resistant brackets or endcaps compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated. Provide hardware that allows for field adjustment or removal of shade roller tube and other operable hardware component without removal of brackets and end or center supports.

2.1.2.5 Shade Cloth

- a. Shade Material: Light-filtering fabric: Openness 3 percent.
- b. Shade Cloth Bottom (Hem) Bar: Steel or extruded aluminum. Provide shade bar enclosed in sealed pocket of shade band material.

2.1.2.6 Installation Accessories

- a. Front Fascia: L-shaped aluminum extrusion to conceal shade roller and hardware that snaps onto end caps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands. Provide manufacturers standard height fascia as required to conceal roller and shade band assembly when shade is fully open.
- b. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure. Provide manufacturers standard height fascia as required to conceal roller and shade band assembly when shade is fully open.
- c. Endcaps: Extruded aluminum with universal design suitable for mounting to window mullions. Provide size compatible with roller size. Provide end cap covers matching fascia/headbox finish.

2.1.2.7 Room Darkening Shades

Provide room darkening (black-out) window shades designed to eliminate all visible light gaps when shades are fully closed and conform with the following:

- a. Provide roller tube made of aluminum. Provide shop fabricated light traps consisting of a head box to house the roller shade, and U-shaped channels to serve as guides for the shade along the sides and to receive the bottom edge of the shade along the sill.
- b. Provide light trap made of sheet steel having a minimum thickness of 22 gauge or anodized, extruded, aluminum. Provide legs of the channels not less than 1-3/4 inches long and separated by the minimum distance that permits free operation of the shade. Edges of light trap coming into contact with the shade cloth are smooth pile light seal. The exposed face of the head box is hinged or removable for access to the shade roller. The interior or unexposed surfaces of the light trap have a finish coat of flat black enamel. The exposed portions of the light trap have a factory-applied priming coat of gray paint.
- c. Provide type of cloth for blackout purposes. Provide shade from a single piece of PVC fiberglass.
- d. Fit the bottom edge of the shade with a steel operating bar. Shades to engage positively with bottom rail through operating bar or chain pull. Paint bars with flat black enamel. Make pull cords of No. 4 braided nylon or beaded chain having not less than 175 pounds breaking strength.

2.1.3 Manually Operated Shades with Dual Rollers

2.1.3.1 Chain-and-Clutch Operating Mechanisms

Provide continuous-loop bead chain and clutch that stops shade movement when bead chain is released; shade to be permanently adjusted and lubricated.

2.1.3.2 Bead Chains

Provide bead chain from #10 stainless steel rated to 90 lb. minimum breaking strength with pull chain tensioning device complying with ANSI/WCMA A100.1. Provide positive mechanical engagement of drive mechanism to shade roller tube. Center bead chain placement for right or left- hand operation.

- a. Loop Length: Full length of roller shade.
- b. Limit Stops: Allows shade to stop when chain is released. Provide limit stops to prevent shade from being raised or lowered too far.
- c. Chain-Retainer Type: Clip, jamb mount.

2.1.3.3 Rollers

Provide corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shade bands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shade bands for service.

- a. Dual Shade-Roller Mounting Configuration: Offset.
- b. Inside Roller: Drive-End Location: Left side of interior face of shade. Direction of Shade cloth Roll: Regular, from back (exterior face) of roller.
- c. Outside Roller: Drive-End Location: Right side of interior face of shade. Direction of Shade cloth Roll: Regular, from back (exterior face) of roller.
- d. Shade cloth-to-Roller Attachment: Manufacturer's standard method. Adhesive attachment is not acceptable.

2.1.3.4 Mounting Hardware

Provide corrosion resistant brackets or endcaps compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated. Provide hardware that allows for field adjustment or removal of shade roller tube and other operable hardware component without removal of brackets and end or center supports.

2.1.3.5 Inside Shade Cloth

- a. Shade Material: Light-blocking fabric.
- b. Shade Cloth Bottom (Hem) Bar: Steel or extruded aluminum. Provide shade bar enclosed in sealed pocket of shade cloth material.

2.1.3.6 Outside Shade Cloth

- a. Shade Material: Light-filtering fabric: Openness 3 percent.
- b. Shade Cloth Bottom (Hem) Bar: Steel or extruded aluminum. Provide shade bar enclosed in sealed pocket of shade cloth material.

2.1.3.7 Installation Accessories

- a. Front Fascia: L-shaped aluminum extrusion to conceal shade roller and hardware that snaps onto end caps without requiring exposed fasteners of any kind. Fascia can be mounted continuously across two or more shade bands. Provide manufacturers standard height fascia as required to conceal roller and shade band assembly when shade is fully open.

2.2 COLOR

Provide color, pattern and texture for metal trim and shade fabric as indicated; colors listed are not intended to limit the selection of equal colors from other manufacturers.

PART 3 EXECUTION

3.1 FIELD MEASUREMENTS

After becoming familiar with details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Provide roller window shades, complete with necessary brackets, fittings, and hardware in accordance with paragraph ROLLER WINDOW SHADE PLACEMENT SCHEDULE as indicated.

Perform installation in accordance with the approved detailed drawings and manufacturer's installation instructions. Install units level, plumb, secure, and at proper height and location relative to window units. Provide and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Do not start installation until completion of room painting and finishing operations.

3.3 CLEAN-UP

Upon completion of the installation, clean window treatments and exposed components as recommended by manufacturer. Adjust window treatment for form and appearance and proper operating condition. Repair or replace damaged units as directed by the Contracting Officer. Isolate metal parts from direct contact with concrete, mortar, or dissimilar metals. Ensure shades installed in recessed pockets can be removed without disturbing the pocket. The entire shade, when retracted, is contained inside the pocket. For shades installed outside the jambs and mullions, overlap each jamb and mullion 0.75 inch or more when the jamb and mullion sizes permit. Include all hardware, brackets, anchors, fasteners, and accessories necessary for a complete, finished installation.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 12 - FURNISHINGS

SECTION 12 50 00.13 10

FURNITURE AND FURNITURE INSTALLATION

08/17, CHG 1: 11/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 SERVICES
- 1.4 FURNITURE PURCHASE
- 1.5 ALTERNATE DESIGN
 - 1.5.1 Desk and Workstation Size and Configuration
 - 1.5.2 Filing and Storage Size and Configuration
 - 1.5.3 Furniture Requirements
 - 1.5.4 Layout
- 1.6 AUTHORIZED DEALER, CERTIFIED FURNITURE INSTALLERS, LICENSED ELECTRICIAN AND CERTIFIED TELECOMMUNICATIONS INSTALLER
- 1.7 DELIVERY, STORAGE AND HANDLING
 - 1.7.1 Delivery
 - 1.7.2 Furniture Inspection
 - 1.7.3 Storage
 - 1.7.4 Furniture Staging Area
- 1.8 WARRANTY

PART 2 PRODUCTS

- 2.1 PRODUCT SUSTAINABILITY CRITERIA
 - 2.1.1 Energy Efficient Equipment
 - 2.1.2 Reduced VOC's for Furniture
 - 2.1.3 Recycled Content of Furniture
 - 2.1.4 Bio-Based Content of Furniture
- 2.2 REFERENCE TO MANUFACTURER NAMES AND COLORS
- 2.3 FURNITURE REQUIREMENTS
 - 2.3.1 EXISTING FURNITURE (GOVERNMENT FURNISHED/CONTRACTOR INSTALLED-GF/CI)
 - 2.3.1.1 Existing Furniture Communications
 - 2.3.2 Construction
 - 2.3.3 Locks and Keying
 - 2.3.4 Receptacle Bodies and Device Cover Plates
 - 2.3.5 Keyboard Tray
 - 2.3.6 Fabric and Finish
 - 2.3.6.1 Fabric
 - 2.3.6.2 Finishes
- 2.4 FURNITURE LAYOUT

PART 3 EXECUTION

- 3.1 BUILDING EXAMINATION
- 3.2 BUILDING PROTECTION
- 3.3 INSTALLATION

- 3.3.1 Installation Drawings
- 3.3.2 Furniture Installation Procedures
- 3.3.3 Furniture Communications Installation
- 3.4 CLEANING
- 3.5 OPERATION AND MAINTENANCE MANUALS
 - 3.5.1 Assembly Manuals
 - 3.5.2 Installation Instructions
 - 3.5.3 Maintenance Manuals
 - 3.5.4 Electrical System Manuals
 - 3.5.5 Special Tools
 - 3.5.6 Furniture Drawings
 - 3.5.7 Furniture Listing
 - 3.5.8 Order Form Documentation

-- 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.

The requirements of this specification also apply to systems furniture unless otherwise specified in Section 12 59 00 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 1-4 2020; Interpretation 5-8 2021; Addenda AS-CB 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 E 1590 (2017) Standard Test Method for Fire Testing of Mattresses

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

BIFMA INTERNATIONAL (BIFMA)

ANSI/BIFMA M7.1 (2011; R 2016) Test Method for Determining VOC Emissions from Office Furniture Systems, Components and Seating

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-568.2 (2018d) Balanced Twisted-Pair
Telecommunications Cabling and Components
Standards

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1632 Standard for the Flammability of
Mattresses and Mattress Pads (FF 4-72
Amended)

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; G

SD-02 Shop Drawings

Installation Drawings; G, A/E

Grommet, Power and Communication Units, and Wire Management Locations; G, A/E

SD-03 Product Data

Product Data; G, A/E

Product Style Options; G, A/E

SD-04 Samples

Fabric and Finishes; G, A/E

SD-07 Certificates

Authorized Dealer; G

Certified Furniture Installers; G

Licensed Electrician; G

Certified Telecommunications Installer; G

Manufacturer's Certification; G

Warranty; G

SD-10 Operation and Maintenance Data

Furniture, Data Package 1; G, A/E

SD-11 Closeout Submittals

Energy Efficient Equipment; S

Reduced VOC's for Furniture; S

Recycled Content of Furniture; S

Bio-Based Content of Furniture; S

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. Compete the furniture purchase by obtaining a minimum of (3) separate proposals. Furniture is subject to FAR clause 52.236-5 Materials and Workmanship.

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, Section 12 59 00 Systems Furniture, and the specifications/data sheets 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 - see Section 12 59 00 Systems Furniture

- 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

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. Systems furniture is specified in Section 12 59 00 SYSTEMS FURNITURE. 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. 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 EXISTING FURNITURE (GOVERNMENT FURNISHED/CONTRACTOR INSTALLED-GF/CI)

2.3.1.1 Existing Furniture Communications

2.3.2 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.

(c) Mattresses must comply with 16 CFR 1632 and ASTM E 1590.

- 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 storage must be finished.
- g. Provide chair casters and glides appropriate for the floor material they are located on, such as carpet and resilient flooring.

2.3.3 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 alike 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. Leave keys in locks Inventory keys, label keys by lock number, room number and furniture item and turn over inventory and keys to the Contracting Officer.

2.3.4 Receptacle Bodies and Device Cover Plates

Provide furniture panel faceplates and receptacle body types as specified in FF&E Package submittal and the 12 59 00 SYSTEMS FURNITURE specifications. 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: have distinct markings and be of a different color than other receptacles

2.3.5 Keyboard Tray

Provide worksurfaces that are capable of accepting an articulating keyboard tray at locations indicated. The keyboard tray must be capable of fully recessing under the work surface and extending to give the user full access to the keyboard. The keyboard tray must have height adjustability and positive and negative tilting capability and have 180-degree swing side travel rotation. The keyboard tray must have a wrist support and include a mouse pad at the same level as the keyboard that can accommodate both right and left handed users.

2.3.6 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.

2.3.6.1 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. Assure that topical or soil inherent treatment is a low volatile compound product and complies with ANSI/BIFMA M7.1 and/or Greenguard (GEI) or similar third party certifications.
- d. Comply with double rub testing as specified in the FF&E Package submittal. Fabric for seating must comply with a minimum of 100,000 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 submittal.
- f. See FF&E Package submittal for additional information.

2.3.6.2 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. Finishes must be neutral in color.
- e. Plastic laminate worksurfaces and table tops must be neutral in color and must have a pattern to help hide soiling.
- f. See FF&E Package submittal 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 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-568.2 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.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 12 - FURNISHINGS

SECTION 12 59 00

SYSTEMS FURNITURE

08/17, CHG 1: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 CERTIFICATIONS
 - 1.3.1 Certified Sustainably Harvested Wood
 - 1.3.2 Indoor Air Quality Certifications
 - 1.3.2.1 Office Furniture Systems and Seating
- 1.4 QUALITY ASSURANCE
 - 1.4.1 General Safety
 - 1.4.2 Fire Safety
 - 1.4.3 Electrical System
 - 1.4.4 Detail Drawings
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 MATERIALS
- 2.2 SYSTEM DESCRIPTION
 - 2.2.1 Workstations
 - 2.2.2 Samples
 - 2.2.3 Mock-up
 - 2.2.4 Alternate Design
 - 2.2.4.1 Component Requirements
 - 2.2.4.2 Wiring Configuration
 - 2.2.5 Performance Requirements
 - 2.2.5.1 Selected Components
 - 2.2.5.2 Panel Acoustics
 - 2.2.5.3 Panel Glazing
 - 2.2.6 Pattern and Color
- 2.3 SYSTEMS FURNITURE
 - 2.3.1 Panel System Components
 - 2.3.2 Panel Finishes
 - 2.3.3 Raceways
 - 2.3.4 Leveling Glides
 - 2.3.5 Connection System
 - 2.3.6 Wall Mounted Panels
 - 2.3.7 Glazed Panel Inserts
- 2.4 DESK-BASED SYSTEM
- 2.5 WORK SURFACES
 - 2.5.1 Construction
 - 2.5.2 Finishes
- 2.6 PEDESTALS
 - 2.6.1 Construction
 - 2.6.2 Finishes

2.6.3	Drawer Requirements
2.7	STORAGE
2.7.1	Shelf Unit Construction
2.7.2	Overhead Cabinet Construction
2.7.3	Lateral File, Vertical File and Book Case Construction
2.7.4	Personal Storage Tower Construction
2.7.5	Finish
2.8	ACCESSORIES
2.8.1	Coat Hook
2.8.2	Keyboard Tray
2.8.3	Tackboards
2.8.4	Erasable Marker Boards
2.8.5	Paper Management Unit
2.8.6	Wall Mounted Components
2.8.7	Signage
2.8.8	Monitor Arm
2.9	MISCELLANEOUS HARDWARE
2.10	LOCKS AND KEYING
2.11	POWER AND COMMUNICATIONS
2.11.1	Panel Raceways
2.11.2	Power Distribution
2.11.2.1	Receptacles
2.11.2.2	Power Cabling Variations
2.11.3	Electrical Connections
2.11.3.1	Internal Connections
2.11.3.2	Connections to Building Services
2.11.4	Wire Management
2.11.5	Circuit Layout
2.11.6	Task Lighting
2.11.6.1	Luminaire Configuration
2.11.6.2	Wiring
2.11.6.3	Control Device
2.11.7	Communications
2.11.8	Special Systems
PART 3	EXECUTION
3.1	INSTALLATION
3.2	CLEANING

-- End of Section Table of Contents --

SECTION 12 59 00

SYSTEMS FURNITURE
08/17, CHG 1: 08/18

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (2015) Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

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 1-4 2020; Interpretation 5-8 2021; Addenda AS-CB 2022) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM C423 (2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

ASTM C1048 (2018) Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

ASTM E290 (2014) Bend Testing of Material for Ductility

BIFMA INTERNATIONAL (BIFMA)

ANSI/BIFMA M7.1 (2011; R 2016) Test Method for Determining VOC Emissions from Office Furniture Systems, Components and 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 X7.1 (2011; R2016) Standard for Formaldehyde
and TVOC Emissions

ANSI/BIFMA e3 (2014; R2019) Furniture Sustainability
Standard, Section 7.6.2

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001 (2015) Principles and Criteria for Forest
Stewardship

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA WD 1 (1999; R 2020) Standard for General Color
Requirements for Wiring Devices

NEMA WD 6 (2016) Wiring Devices Dimensions
Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 101 (2021) Life Safety Code

NFPA 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

PROGRAMME FOR ENDORSEMENT OF FOREST CERTIFICATION (PEFC)

PEFC ST 2002:2013 (2015) PEFC International Standard Chain
of Custody of Forest Based Products
Requirements

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

TIA-569 (2019e) ADDENDUM 1 2019) Commercial
Building Standard for Telecommunications
Pathways and Spaces

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)

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

UL 1286 (2008; Reprint Apr 2021) UL Standard for
 Safety Office 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

Detail Drawings; G, AE

SD-03 Product Data

Warranty; G, AE

Workstations; G, AE

Power and Communications; G, AE

Communications; G, AE

Recycled Content for system furniture components; S

Energy Star Label for Task Lighting; S

SD-04 Samples

Workstations; G, AE

Mock-up; G, AE

Samples

SD-06 Test Reports

Selected Components; G, AE

Panel Acoustics; G, AE

Fire Safety; G, AE

Electrical System; G

SD-07 Certificates

Workstations

Indoor Air Quality for Systems Furniture and Seating; S

Certified Sustainably Harvested Wood Furniture; S

SD-10 Operation and Maintenance Data

Assembly Manuals; G, AE

Maintenance Manuals; G, AE

Cleaning; G, AE

Electrical System; G, AE

Installation; G

1.3 CERTIFICATIONS

1.3.1 Certified Sustainably Harvested Wood

Provide wood furniture certified as sustainably harvested by FSC STD 01 001, ATFS STANDARDS, CSA Z809-08 (R2013), SFI 2015-2019, or other third-party program certified by PEFC ST 2002:2013 to the greatest extent feasible. Provide a letter of certification of sustainably harvested wood signed by the wood furniture supplier. Identify certifying organization and their third-party program name and indicate compliance with chain-of-custody program requirements. Submit product data for certified sustainably harvested wood furniture.

1.3.2 Indoor Air Quality Certifications

1.3.2.1 Office Furniture Systems and Seating

Provide systems furniture and seating tested according to ANSI/BIFMA M7.1 Standard Test Method for Determining VOC Emissions. Provide at least 95 percent of office furniture system workstations and seating units in compliance with ANSI/BIFMA X7.1 Standard for Formaldehyde and TVOC Emissions and at least 50 percent of office furniture system workstations and seating units in compliance with ANSI/BIFMA e3 Furniture Sustainability Standard, Section 7.6.2. Submit product data demonstrating testing compliance for Indoor Air Quality for systems furniture and seating.

1.4 QUALITY ASSURANCE

1.4.1 General Safety

Provide workstation products free of rough or sharp edges. Provide panel supported components with a positive, integral locking device which secures components without the use of additional screws or clamps to prevent the components from being accidentally pulled or knocked off the panels. Provide desk-based workstation components with an option for a positive, integral locking device that secures components to the base units.

1.4.2 Fire Safety

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. Do not exceed 25 for Class A, 75 for Class B, and 200 for Class C for panel flame spread and 450 for Class A, B and C panel smoke development.

1.4.3 Electrical System

Task lights are required to be UL listed and installation of task lighting must meet the requirements of NFPA 70. The electrical system must meet the requirements of UL 1286. Submit three sets of electrical system manuals describing the functions, configuration, and maintenance of the electrical system (power, communications, data). This material may be included in the Assembly or Maintenance manuals at the Contractor's option.

1.4.4 Detail Drawings

Submit detail drawings showing communications, electronic data processing (EDP) and local area network (LAN); locations may be provided as a separate submittal from remaining workstation drawings. Provide drawing requirements, which are the furniture manufacturer's responsibility, as a single submittal. Provide electronic drawings to the user for future re-configuration in the software package requested by the user. Include in the electronic drawings all modifications made during installation. As a minimum, submit the following:

- a. Overall reference drawings: Drawings showing workstation locations and overall plan view within each floor in a scale of 1/8 inch = 1 foot. Layouts must reflect field verified conditions and clearly illustrate the overall space planning concept and intent.
- b. Installation drawings: Drawings showing workstations, panels, components, and plan view within each floor. Identify workstations by workstation type; submit drawings showing the proposed workstation installation at a scale of 1/4 inch = 1 foot, unless otherwise specified. Installation drawings must reflect field verified conditions.
- c. Workstation elevations: Dimensioned workstation elevations showing each type of workstation with panel frame configurations and all components identified with manufacturer's catalog numbers. Draw elevations at 1/2 inch = 1 foot scale.
- d. Panel drawings: Panel drawings showing locations and critical dimensions from finished face of walls, columns, panels, including clearances and aisle widths. Key assemblies to a legend which includes width, height, configuration and composition of frame covers finishes and fabrics (if different selections exist within a project), power or nonpower, connectors and wall mount hardware. Coordinate panel placement with location of electrical, voice/data LAN, SIPRNet, NIPERNet, mechanical and fire protection fixtures. Drawings must reflect field verified conditions.
- e. Electrical drawings: Drawings showing power provisions including type

and location of feeder components (service entry poles, base or ceiling feeds), activated power receptacles and other electrical components. Wiring configuration (circuiting, switching, internal and external connections) identified and a legend provided as applicable. Identify which receptacles in typical furniture configurations will be connected to controlled building power circuits as applicable to meet ASHRAE 90.1 - IP requirements. Coordinate with electrical drawings.

- f. Wire management capacity drawings.
- g. Communication drawings showing telephone provisions: Drawings indicating the type and location of feeder components and communications jacks with wiring configuration identified where applicable.
- h. Communication drawings showing electronic data processing provisions: Drawings indicating the type and location of feeder components, communications jacks, or accessories with wiring configuration identified where applicable.
- i. Communication drawings showing local area network provisions: Drawings indicating the type and location of feeder components and data jacks with extra ports for future expansion with wiring configuration identified where applicable.
- j. Communications drawings indicating the TIA-568-C.2 pin/pair assignment that will be used for communications outlet as coordinated with the COR.
- k. Reflected ceiling plan for projects specified with power poles.
- l. Drawings indicating cabling is protected at all transition points, and that metallic separation is provided between telecommunication and power wiring in the utility columns and systems furniture track in accordance with TIA-569 and NFPA 70.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver components to the jobsite in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Remove furniture from packaging and store in an unoccupied, dry location that is ventilated. Storage shall be free from dirt and dust, water, and other contaminants, and in a manner that permits easy access for inspection and handling.

1.6 WARRANTY

Warrant the systems furniture for a minimum period of 12 years with the following exceptions: fabrics and other covering materials, and paper handling products for 3 years, LED drivers/power supplies for 5 years, and electromagnetic ballasts for 3 years. Warranties must be signed by the authorized representative of the manufacturer. Present warranties, accompanied by document authenticating the signer as an authorized representative of the guarantor, to the Contracting Officer upon the completion of the project. Guarantee that the workstation products and installation are free from any defects in material and workmanship from the date of delivery. Submit two copies of the warranty.

PART 2 PRODUCTS

2.1 MATERIALS

Provide System Furniture Components with highest recycled content feasible. Provide data identifying percentage of recycled content for system furniture components.

Provide certification of indoor air quality for Office Furniture Systems and Seating.

2.2 SYSTEM DESCRIPTION

2.2.1 Workstations

This specification establishes the minimum requirements for the acquisition and installation of a complete and usable system of workstations composed of panels, freestanding work surfaces or base units, supporting components, electrical hardware, communications, special electrical features, and accessories. Provide workstation requirements and configurations in accordance with the furniture layout and typical workstation types shown in drawings and specified herein. Provide components and hardware from a single manufacturer that are standard products as shown in the most recent published price lists or amendments. Proposed product must be part of the manufacturer's current line with no intent to discontinue within two years. Submit complete listing of part/model numbers for all components to be provided, including names and codes of components referenced on updated drawings. Provide electrical components from a single manufacturer to the extent practicable (different types of components may be of different manufacturers, but all units of a given component must be from a single source). Conformance with NFPA 70, UL 1286, NFPA 101, and 36 CFR 1191 is required. Coordinate the work of this section with that to be performed under other sections. This specification may include items which are not manufactured by the furniture manufacturer; provide any such items under this section. Submit two complete sets of certificates attesting that the proposed workstation meets specified requirements. Date the certificate after the award of the contract, include the name of the project, and list specific requirements being certified.

2.2.2 Samples

Submit samples as required to obtain final approval. The Government reserves the right to reject any finish samples that do not satisfy the technical or color requirements. Work can not proceed without sample approval in writing from the Contracting Officer. Submit four sets of the finish samples listed below:

- a. Panel, tackboard and overhead door fabric. Minimum 6 by 6 inches with label designating the manufacturer, pattern, color, fiber content, fabric width, fabric weight, fire rating, and use (panel and/or tackboard).
- b. Workstation component finishes. Minimum 2-1/2 by 3 inches with label designating the manufacturer, material composition, thickness, color, and finish.
- c. Personal Task lights (Not overhead task lights).

- d. Panel glazing. Glazing samples with label designating the material and safety ratings.

2.2.3 Mock-up

Submit a Mock-up of an actual workstation reflecting approved finishes and fabrics. Locate the mock-up installation at approved off-site location. Do not order product for the project until the mock-up has been approved. Submit manufacturer's product and construction specifications which provide technical data for furniture system and components specified, including task lighting and illumination performance information. Include adequate information in the literature to verify that the proposed product meets the specification. Review of the mock-up may result in adjustments to the product, layout and finishes. The approved mock-up can be used in installation.

2.2.4 Alternate Design

Manufacturers who are unable to provide workstations that conform exactly to the furniture layouts and typical workstation types shown in the contract drawings, may submit alternate designs 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. In the alternate design provide workstations and components of the same basic size and configuration shown, with only the sizes of the individual components within the workstation changed to meet the standard product of the manufacturer or site conditions.

2.2.4.1 Component Requirements

Provide the types of components or elements as shown on the drawings and as specified in PART 2 PRODUCTS of this specification. Do not reduce the storage capacity, number of workstations accommodated, width of aisles, or workstation configuration.

2.2.4.2 Wiring Configuration

Alternate configurations shall support the circuiting and connection capabilities identified under the provisions pertaining to power distribution of paragraph POWER AND COMMUNICATIONS. Generally any alternate will be acceptable which involves only a variation in size or quantity that exceeds the specified configuration.

2.2.5 Performance Requirements

Panels, frames and frame covers, connection system, work surfaces, pedestals, shelf units, overhead door cabinets, lateral files, locks, accessories, and miscellaneous hardware must meet testing as specified. ISO 9001 certified manufacturers may perform in-house testing. Manufacturers not ISO 9001 qualified will be required to produce testing by an independent testing laboratory. Component specific requirements are listed in appropriate paragraphs.

2.2.5.1 Selected Components

Workstation conformance to ANSI/BIFMA X5.5 and ANSI/BIFMA X5.6 is required with the following exceptions: Panels, or panel supported components conformance to ANSI/BIFMA X5.6 is required. Representative items will be selected for testing based on worst case situations (i.e., the deepest and

widest work surface or shelf). Perform the keyboard drawer or shelf test applying a 50 lb load to the center of the keyboard shelf for a period of 5 minutes. Any loosening of attachments or damage to the operation of the drawer or shelf will be cause for rejection.

2.2.5.2 Panel Acoustics

Provide acoustical panels with a minimum noise reduction coefficient (NRC) of 0.65 when tested in accordance with ASTM C423 and a minimum sound transfer coefficient (STC) of 14 when tested in accordance with ASTM E290. Conduct the test on the entire assembled panel, full face area (the complete core, adhesive, decorative fabric, frame and joining components).

2.2.5.3 Panel Glazing

Tempered glass must conform to ANSI Z97.1 and ASTM C1048, Kind FT, Condition A, Type I, Class 1 Transparent.

2.2.6 Pattern and Color

Provide pattern and color of finishes and fabrics for panel systems, components, and trim as shown in the Furniture, Fixtures and Equipment (FF&E) Package.

2.3 SYSTEMS FURNITURE

2.3.1 Panel System Components

Supply accessories and appurtenances for a completely finished panel assembly with the system. Provide a system capable of structurally supporting cantilevered work surfaces, shelves, files, overhead cabinets, and other components in the configurations shown on the drawings plus more than one fully loaded component per panel per side. Provide panels that are tackable or capable of accommodating fabric covered tackboards, acoustical, and stackable with a system capable of lowering or raising the overall panel assembly height at horizontal connections by removing or adding panel-frames on-site without disturbing adjacent panel components. Provide a panel system that is available in a variety of nominal widths and heights as designated on the drawings. Measure heights from the finished floor to the top of the panel. Supply powered and nonpowered panels that are compatible in height. Coordinate panel heights with the HVAC and electrical designs. Minimum panel thickness is 3 inches thick. Submit three sets of Assembly Manuals describing assembly and reconfiguration procedures.

2.3.2 Panel Finishes

Provide panels in the following options: safety glazed, open frame, tackable fabric, acoustical fabric, marker surface, paint, slat tile, or perforated metal. Frame covers may have different options on either side of the frame. Exposed panel trim to have a factory baked enamel or epoxy powder finish. Filler trim will either match the panel trim or be fabric covered to match the panel fabric. Provide each fabric-faced panel with a seamless width of fabric stretched over the entire face of the panel. The fabric color throughout the installation must be consistent. Curved panels may use adhesives on curved sections. Attach the fabric securely and continuously along the entire perimeter of the panel and allow for easy removal and replacement in the field (with the exception of curved panels).

2.3.3 Raceways

Provide raceways and covers as an integral part of the panel whether powered or nonpowered. Magnet held base covers will not be accepted.

2.3.4 Leveling Glides

Provide precise alignment of adjacent panels and include leveling glides to compensate for uneven floors. Provide quantity and location of leveling glides as recommended by the manufacturer. A minimum 3/4 inch adjustment range is required.

2.3.5 Connection System

Provide connectors which accommodate a variety of configurations as indicated on the drawings to include: a straight line connection of 2 panels (180 degrees), corner connection of 2 panels (90 degrees), T connection of 3 panels (90 degrees), cross connection of 4 panels (all 90 degrees), angle connection of 2 panels (120 degrees), and a connection of 2 panels for setting the panels at any angle. Provide tight connections with continuous visual and acoustical seals. Plastic, painted metal, fabric or wood finish connections are required to match system. Provide connector system that allows removal of a single panel within a typical workstation configuration, without requiring disassembly of the workstation or removal of adjacent panels. Provide for connection of similar or dissimilar heights to include trim pieces to finish the exposed edge. Right angle (90 degree) connections between panels must not interfere with the capability to hang work surfaces and other components on any adjacent panel. Provide, as required, the continuation of electrical and communications wiring within workstations and from workstation to workstation. Filler posts must be level with the top rail.

2.3.6 Wall Mounted Panels

Use wall-mount components when it is necessary to attach panels or vertical panel-frame assemblies to the building walls. Provide structural support for wall panels as required. Panels and other systems furniture components are not be wall mounted unless they are included in the original design.

2.3.7 Glazed Panel Inserts

Provide safety glass glazed panel inserts in accordance with ANSI Z97.1 and ASTM C1048. Acrylic glazing will not be accepted.

2.4 DESK-BASED SYSTEM

Supply accessories and appurtenances for a completely finished desk-based assembly within the system. Provide a desk-based system that is free-standing, independent of panel system support and capable of structurally supporting work surfaces, shelves, and other components in the configurations shown on the drawings. Provide a variety of nominal widths and depths as indicated on drawings.

2.5 WORK SURFACES

2.5.1 Construction

Construct work surfaces to prevent warpage. Fully support work surfaces from the panels or support jointly by the panels and supplemental legs, pedestals, or furniture end panels. Use supplemental end supports only under work surfaces when the work station configuration does not permit full support by the panels. Use metal support brackets to support work surfaces from the panels, provide metal-to-metal fitting to the vertical uprights of the panels, vertically adjustable, to lock the work surfaces in place without panel modifications. Support work surfaces with legs, pedestals, or furniture end panels. Abutting work surfaces must line up closely and be at equal heights when used in side-by-side configurations in order to provide a continuous and level work surface. Provide pre-drilled holes to accommodate storage components, pedestals and additional supports in work surfaces, or drill holes at the job site to accommodate these items. Provide work surfaces in sizes and configurations shown on the drawings. Provide work surfaces in nominal depths of 24 inches, and 30 inches, plus or minus 2 inches, nominal lengths from 24 to 72 inches, and a nominal thickness from 1 to 1-3/4 inches. Provide height adjustable work surfaces from 25 to 52 inches above the finished floor with a mechanical control. Provide corner, peninsula, and counter/transaction work surfaces as shown on the drawings and include hardware necessary to provide firm and rigid support.

2.5.2 Finishes

Provide work surfaces with a finished top surface of high pressure plastic laminate, and a smoothly finished underside. The work surface must not be damaged by ordinary household solvents, acids, alcohols, or salt solutions. Provide metal support brackets that match the color and finish of trim. Provide PVC or laminate edges

2.6 PEDESTALS

Provide drawer configurations and pedestal height as shown on the drawings. Provide the deepest possible pedestal for each work surface size specified. Free standing mobile pedestals to include an attached upholstered seat cushion, and casters. Mobile pedestals must be load bearing and equipped with counterbalance as standard. Provide appropriate height of mobile pedestal so it can be stored under a standard height worksurface.

2.6.1 Construction

Provide pedestals and drawers of steel construction. Securely attach drawer faces to the drawer front.

2.6.2 Finishes

Provide a factory baked enamel finish or powder coated for steel surfaces. Provide steel drawer fronts.

2.6.3 Drawer Requirements

Pedestals must be field interchangeable from left to right, and right to left, and must retain the pedestal locking system capability. Design

pedestals to protect wires from being damaged by drawer operation. Provide pedestals that are support work surfaces and mobile. Drawers must stay securely closed when in the closed position and provide each drawer with a safety catch to prevent accidental removal when fully open. File drawers to be provided with full extension ball bearing drawer slides or rack and pinion suspension. File drawers to be provided with hanging folder frames or rails and capable of hanging side-to-side or front-to-back. Provide dividers with vertical files. Provide box drawers with pencil trays.

2.7 STORAGE

Provide storage units in the sizes and configurations shown on the drawings. Provide task lights under overhead cabinets and shelf units. Depth to accommodate a standard three ring binder.

2.7.1 Shelf Unit Construction

Provide metal construction shelf pan with formed edges. Provide shelf supporting end panels of metal, high density particle board, molded phenolic resin, or molded melamine. Provide relocatable shelf dividers with shelf units.

2.7.2 Overhead Cabinet Construction

Provide metal construction overhead cabinets. Provide doors with a suspension system. Provide overhead cabinet door that retracts over the top of the cabinet and is curved. Overhead cabinet must be ADA accessible.

2.7.3 Lateral File, Vertical File and Book Case Construction

Provide units and file fronts, top and end panels of steel construction. File drawers to be provided with full extension ball bearing drawer slides or rack and pinion suspension. File drawers to be provided with hanging folder frames or rails and capable of hanging side-to-side or front-to-back. Provide dividers with vertical files.

2.7.4 Personal Storage Tower Construction

Provide personal storage tower and components of steel construction. Height of the unit to be the same height as the surrounding panels.

2.7.5 Finish

Provide a factory baked enamel or epoxy powder coat finish for shelves, dividers and top dust cover. Provide either a factory baked enamel, epoxy powder coat or laminate finish for shelf supporting end panels. Shelf bottom is required to match end panel color. Provide metal doors with an exterior finish of factory baked enamel and an interior finish of factory baked enamel or epoxy powder coat. Provide a factory baked enamel finish or epoxy powder coat on metal drawers.

2.8 ACCESSORIES

2.8.1 Coat Hook

Provide one mounted coat hook per workstation.

2.8.2 Keyboard Tray

Provide work surfaces that are capable of accepting an articulating keyboard in locations as shown on the drawings. The keyboard tray must be capable of fully recessing under the work surface and extending to give the user full access to the keyboard. Provide height adjustability, 180-degree swing side travel rotation and negative tilting capability. Include a wrist support and a mouse pad at the same level as the keyboard tray to accommodate either right or left-handed users.

2.8.3 Tackboards

Fabric must be factory installed. Location and size as shown on the drawings.

2.8.4 Erasable Marker Boards

Provide marker boards with a white writing surface that can be easily written on and erased and unaffected by common marker board cleaning/conditioning agents. Include a storage tray and minimum two markers with the markerboard. Size and location as shown on the drawings.

2.8.5 Paper Management Unit

Provide paper management units as indicated on the drawings. Construct these units of coated steel or injection molded plastic to accommodate either legal or letter size lengths.

2.8.6 Wall Mounted Components

Provide wall tracks when components are shown attached directly to wall surfaces. Provide tracks of heavy duty extruded metal with finish and color matching the the panel trim. Provide vertically aligned tracks slotted on 1 inch centers in heights required that match slot spacing for components.

2.8.7 Signage

Provide panel mounted signage composed, at a minimum, of aluminum frame, back panel, clear plastic cover, and hanging device. Provide signage approximately 3 by 8 inches and capable of receiving a replaceable paper insert. Provide software for creating text in PC computers for owner production of replacement paper inserts after project completion.

2.8.8 Monitor Arm

Provide monitor arm that allows 360 degree monitor rotation for portrait and landscape viewing, and 60 degree range of lateral and vertical monitor tilt for additional viewing adjustability. Provide monitor arm that supports monitors weighing 7 to 19 lbs. Provide dual monitor arm for 2 screens.

2.9 MISCELLANEOUS HARDWARE

Provide brackets, supports, hangers, clips, panel supported legs, connectors, adjustable feet, cover plates, stabilizers, and other miscellaneous hardware that contribute to a complete and operable furniture system.

2.10 LOCKS AND KEYING

Provide overhead cabinets, vertical files, personal storage towers, pedestals and lateral files with keyed locks, unless otherwise noted. Provide field changeable lock cylinders with a minimum of 50 different key options. Key each workstation individually, and key locks alike within a workstation. Provide lockable drawers within a pedestal either by a central lock that controls all pedestals under one work surface or an individual keyed lock in each pedestal. Key alike central file and storage units which are grouped together but are not a part of a workstation unless otherwise specified. Provide two keys for each lock or two keys per workstation when keyed alike, and provide three master keys per area as indicated. Number keys and lock cylinders for ease of replacement. Clearly label locks with a key number, except for those manufacturers who have removable format locks.

2.11 POWER AND COMMUNICATIONS

Provide both powered and nonpowered panels with base raceways capable of distributing power circuits, communication cables and data lines. Provide nonpowered bases that are capable of easy field conversion to powered base without requiring the panel to be dismantled or removed from the workstation. Provide panels able to support lay-in cabling and having a large capacity for power and data. Provide ample space for storing excess wires and fiber optic cables in the interior of the spine wall frame. Provide easy access to power and data systems in the spine wall without having to move return panels or components. Provide the ability for the spine wall system to supply power to a wall-attached panel system and/or an adjacent desk system. A termination center or utility closet may be utilized in the wall or at the end of a panel run. Provide copper cable assemblies, wiring harnesses or electrified bus for the system and meet the requirements of UL 1286 and NFPA 70, Article 605. Provide conductors with 20 amp 90 degree C, #12 AWG wires (unless indicated otherwise) or the equivalent in the bus configuration. A single circuit must not serve more than four (4) cubicles or workstations under any circumstances. The label or listing of Underwriter's Laboratories, Inc. will be accepted as evidence that the material or equipment conforms to the applicable standards of that agency. In lieu of this label or listing, submit a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures of UL and that the materials and equipment comply with contract requirements. Electrical work not addressed in this section must conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.11.1 Panel Raceways

Provide panels that have hinged or removable covers that permit easy access to the raceway when required but are securely mounted and cannot be accidentally dislodged under normal conditions. Place raceways in locations such as the base, beltline, and below and above the beltline. The raceway must not extend past either panel face by more than 1/2 inch. Provide metal or plastic covers which attach securely to the raceway as required and match the finish and color of the panel trim. Provide a minimum of 2 knockouts (doors) per side for power receptacles and communications jacks as indicated in raceways in full size over 24 inches powered panels on panel frames.

2.11.2 Power Distribution

Provide power distribution as indicated on the drawings. Provide an

internal power and communications raceway and the capability of disconnecting and connecting external circuits to the electrified raceway in the panel. Capacity for at least six 4-pair category 6 cables or 8 strand OM4 fiber optic is required for the communications receiving raceway. Power and communications wiring may share a common wireway if a metal divider is included to ensure electrical isolation. Provide doors or access openings for entry of communications cable. Provide the electrified power raceway for the 8-wire configuration indicated. Unless otherwise indicated, allocate conductors of the 8-wire system as follows (4-2-2 shared neutral plus dedicated circuit, 3+1): the three-phase system will have one equipment ground, one isolated ground, two oversized (133 percent minimum) neutral, and four phase conductors; one neutral will be dedicated to a single phase conductor, one neutral will be shared by three phase conductors, and no neutral conductor will be connected to multiple phase conductors of the same phase; the isolated ground conductor will use by the circuit with the dedicated neutral conductor and the equipment ground conductor will use by the circuit with the shared neutral conductor.

2.11.2.1 Receptacles

Provide power receptacles in the powered panels. Place devices at the locations indicated on the plans connected to the designated circuits. Unless otherwise indicated, receptacles must be 20 amp (NEMA 5-20R) commercial grade conforming to NEMA WD 1 and NEMA WD 6. Provide 10 percent spare devices of each type shown on these plans if receptacles are not interchangeable or will not permit field adjustment of phase and circuit selection. All receptacles are required to be of the duplex configuration; unless otherwise indicated, special use receptacles are required to be of the simplex configuration with the blade/pin arrangement identified on the plans. Coordinate the color of receptacle bodies with the color of the panel trim. Isolated ground receptacles must be of a different color than other receptacles. Furniture receptacles whose building power supply circuit is controlled by an energy management system, timer, or some other automatic means or are provided with local automatic control, will be identified using the standard symbol shown in NFPA 70 Figure 406.3(E); each outlet on a multi-outlet receptacle shall be identified individually. Provide field applied identification that is permanent; stick-on or non-setting adhesives are not acceptable. Provide 5 percent spare devices for each configuration and type of receptacle. Provide a minimum of 5 receptacle removal tools for systems that require special tools for proper receptacle removal.

2.11.2.2 Power Cabling Variations

The paragraph Power Distribution has identified specific cabling configurations. Since universal conventions have not been established, variant configurations available from various manufacturers will be considered. Alternates shall allow the same circuiting, device connections, neutral and ground separation, and upstream feeder connections as shown on the plans. See paragraph ALTERNATE DESIGN. An example of an acceptable variation includes the use of a manufacturer's configuration which allocates individual conductors differently, but which has the same quantity of conductors and allows devices to be physically connected in the field as shown on the plans. It is not necessary that the manufacturer's labeling codes or terminology match the designations used on project plans or in the specifications; however, neutrals and grounds shall have insulation color coded per standard practice or be

provided with tags, colored tape, colored ribbons or similar identification. (The reference to "dedicated" conductors in this specification pertains to circuit connections upstream and load connections downstream of panels; it is not necessary that manufacturer's designations correspond.)

2.11.3 Electrical Connections

2.11.3.1 Internal Connections

Utilize straight or flexible plug/receptacle connector assemblies for internal panel-to-panel power connections and provide the powered configurations shown on the drawings.

2.11.3.2 Connections to Building Services

Supply external power and communications services to the panels via hard wired base entry junction box assemblies. Extend wiring from building services to the entry modules or panel bases in metal conduit or tubing or in flexible liquidtight conduit 6 foot maximum.

2.11.4 Wire Management

Provide wire management capability at all workstations and accommodate all cable types specified, including the applicable manufacturer required bending radius at corners. Design raceways and interfaces to the raceways to accommodate the bend radius as shown in TIA-569 for Category fiber optic cables communication wiring. Copper and fiber cabling shall meet the requirements of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. The capability may be accomplished by cable access cutouts (1 minimum per work surface), covered wire management troughs in vertical end panels, horizontal wiring troughs, internal midpanel (beltline) raceways, or rear gaps (between the back edge of the work surface and the facing support panel). Provide grommet kits or another suitable finish arrangement for all cable cutouts. Provide accessories for an externally mounted vertical and horizontal wire management and concealment system as recommended by the manufacturer. Supply horizontal wire managers for mounting under all work surfaces. Attach the wire managers either to the underside of the work surface or to the vertical panel without damaging the face. Exposed or loose wiring will not be acceptable. Wire managers must be prefinished and secure, conceal, and accommodate outlet cords as well as electrical and communications wiring. Wire channels are required to match color of panel trim, attach by means of clip-on attachment, and conceal wires routed vertically. Separate power wiring from communication wiring by use of separate raceways or by placement of channels in joint use troughs or wireways.

2.11.5 Circuit Layout

Provide the circuit layout for workstations on the drawings. Connect devices to the designated circuits in the neutral, ground, and automatic control configurations indicated. Connections must be made to the building electrical distribution system as shown on the contract drawings and in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.11.6 Task Lighting

Provide task lights with light emitting diode (LED) technology to include a built-in reflector and shielding device that prevents direct glare into

an occupant's eyes when they are in a typical working position. Provide task light size and placement on the contract drawings. It is required that lights be a standard component of the manufacturer's workstation products, and the ends of the task light length can not extend beyond the edges of the overhead cabinet. Enclose task light power cords within vertical wire cover or clips. Luminaires shall be UL approved for use in the configurations indicated on the drawings. Provide task lighting that is Energy Star labeled. Provide data identifying Energy Star label for task lighting.

2.11.6.1 Luminaire Configuration

Provide luminaires and lamps as specified in Section 26 51 00 INTERIOR LIGHTING and modified herein. For undershelf or undercabinet lighting, provide luminaires that are light emitting diode (LED) type and have prismatic lenses, baffles, or other shielding device configured to minimize glare by shielding the lamp from view of the seated user. Easily removable diffusers, grilles, or other coverings are required to allow for cleaning and relamping. For LED-type task lighting, power consumption shall not exceed 8 watts per foot. Correlated Color Temperature (CCT) of task lighting shall match the CCT of the ambient room lighting. Provide an easily accessible on-off switch and one ballast or driver per luminaire. A variable intensity control is acceptable if the low setting is equivalent to "off" with zero energy consumption. Multiple level switching is also acceptable. For LED type technology, ganged luminaires or shared drivers are permitted for up to 4 continuous feet in length. A single driver designed for use with an individual LED housing of greater than 4 feet in length is allowed.

2.11.6.2 Wiring

Provide each luminaire with a 6 foot minimum, factory installed, heavy duty electrical cordset with a grounded plug for luminaires that are mounted on the same wall as the receptacle. Provide luminaires mounted on non-powered wall with a 9 foot minimum, factory installed heavy duty electrical cordset with a grounded plug. Direct or hard wire connections are not acceptable. Unless otherwise indicated, conceal cord. Built-in cord concealment is required within panels or utilize field installed, manufacturer approved accessories. Cords may be extended through dedicated channels located at any point within panels or may be placed in vertical slots or in the space between panels if held in place by retainers and concealed by a cover plate. Vertical wire managers are required to be prefinished and cut to size and shall extend from the task light level down to the top of the work surface below the task light. Attach each manager to a panel vertical edge or connector strip without damage to the surfaces.

2.11.6.3 Control Device

Provide occupancy sensors with "manual ON", "automatic OFF" controls for luminaire control.

2.11.7 Communications

Communications wiring will be extended to, and installed in, the electrified panels as shown on the plans. Install communications jacks at designated locations. Communications work may be performed in conjunction with the installation of workstations or may be separately executed at the Contractor's option; however, equipment, materials, and installation must

conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and properly coordinate all interfaces.

2.11.8 Special Systems

Provide management for secure and nonsecure power, computer and telecommunications cabling through designated raceway systems. Separate secure distribution from nonsecure distribution by running secure lines along top located raceway and nonsecure along the bottom of the workstation panel.

PART 3 EXECUTION

3.1 INSTALLATION

Install the workstations using certified installers in accordance with manufacturer's recommended installation instructions. A licensed electrician is required to hardwire the workstations. Install workstation components level, plumb, square, and with proper alignment with adjoining furniture. Securely interconnect and attach components to the building where required. Provide three sets of special tools and equipment necessary for the relocation of panels and other components. Verify that equipment is properly installed, connected, and adjusted.

3.2 CLEANING

Upon completion of installation, clean and polish all products and leave the area in a clean and neat condition. Any defects in material and installation are required to be repaired, and damaged products that cannot be satisfactorily repaired are required to be replaced. Submit three sets of Maintenance Manuals describing proper cleaning and minor repair procedures.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 14 - CONVEYING EQUIPMENT

HYDRAULIC PASSENGER ELEVATORS

05/16

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
 - 1.2.1 Shop Drawing Requirements
 - 1.2.2 Product Data Requirements
 - 1.2.3 Design Data
 - 1.2.3.1 Reaction Loads
 - 1.2.3.2 Heat Loads
 - 1.2.3.3 Emergency Power Systems
 - 1.2.4 Welders' Requirements
 - 1.2.5 Maintenance Control Program (MCP)
- 1.3 QUALITY ASSURANCE
 - 1.3.1 Qualification
 - 1.3.1.1 Elevator Contractor's Elevator Technicians
 - 1.3.2 Manufacturers' Technical Support
 - 1.3.3 Operation and Maintenance Data
 - 1.3.4 Wiring Diagrams
 - 1.3.5 Machine Room/Control Room Cabinet
- 1.4 NEW INSTALLATION SERVICE
 - 1.4.1 Periodic Elevator Certification Inspection and Testing
- 1.5 FIRE PROTECTION SYSTEM
 - 1.5.1 Fire Alarm Initiating Devices
 - 1.5.2 Fire Sprinklers
 - 1.5.3 Shunt Trip Disconnect

PART 2 PRODUCTS

- 2.1 ELEVATOR DESCRIPTION
 - 2.1.1 Elevator Design Parameters
 - 2.1.1.1 Elevator No.1 - Emergency Medical Service Accessibility (EMSA)
 - 2.1.2 Cab Enclosure and Hoistway Entrance Assemblies
- 2.2 ELEVATOR OPERATION
 - 2.2.1 Single, Two-Stop, Automatic Operation
- 2.3 SPECIAL OPERATION AND CONTROL
 - 2.3.1 Keys for Elevator Key Switches
 - 2.3.2 Firefighters' Emergency Operation (FEO)
 - 2.3.2.1 Firefighters' Emergency Operation (FEO) Key Box
 - 2.3.3 Hoistway Access Operation
 - 2.3.4 In-Car Inspection Operation
 - 2.3.5 Independent Service
 - 2.3.6 Selective Door Operation
 - 2.3.7 Elevator Auxiliary Power Operating System
- 2.4 ELEVATOR DRIVE SYSTEM
 - 2.4.1 Hydraulic Pump Unit
 - 2.4.1.1 Pump Motor
 - 2.4.2 Hydraulic Controls and Equipment

- 2.4.2.1 Hydraulic Control Valve
- 2.4.2.2 Hydraulic Overspeed Safety Valve
- 2.4.3 Hydraulic Piping and Accessories
 - 2.4.3.1 Containment of Hydraulic Oil Supply Line
- 2.4.4 Hydraulic Elevator Type
 - 2.4.4.1 Cylinder-Plunger (Jack) Unit
- 2.5 CONTROL EQUIPMENT
 - 2.5.1 Motor Control Equipment
 - 2.5.2 Elevator Microprocessor Controller
 - 2.5.2.1 Elevator Controller Interface Cabinet
 - 2.5.2.1.1 Elevator Microprocessor Human Interface
 - 2.5.2.2 Software and Documentation
 - 2.5.2.3 Elevator Controller Certification
- 2.6 OPERATING PANELS, SIGNAL FIXTURES, AND COMMUNICATIONS CABINETS
 - 2.6.1 Car and Hall Buttons
 - 2.6.2 Passenger Car-Operating Panel
 - 2.6.2.1 Passenger Controls
 - 2.6.2.2 Service Controls
 - 2.6.2.3 Certificate Window
 - 2.6.2.4 Emergency Signaling Devices
 - 2.6.3 Elevator In-Car Position Indicators
 - 2.6.4 Elevator In-Car Direction Indicators
 - 2.6.5 Hall Call Landing Fixtures
 - 2.6.5.1 Designated Landing Hall Call Fixture
 - 2.6.5.1.1 Location of COMMUNICATION MEANS FAILURE (CMF) Visual Signal
 - 2.6.5.1.2 COMMUNICATION MEANS FAILURE (CMF) Visual and Audible Signal Operation
 - 2.6.5.1.3 Firefighters' Emergency Operation Phase I Switch and Visual Signal
 - 2.6.6 Elevator Car Position and Direction Indicators and Car Arrival Signal
 - 2.6.7 Designated Landing Elevator Identification Fixture
 - 2.6.8 Emergency or Standby Power
- 2.7 CAR DOOR EQUIPMENT
 - 2.7.1 Car Door Operator
 - 2.7.2 Infra-red Curtain Unit
- 2.8 PASSENGER ELEVATOR GUIDES, PLATFORM, AND ENCLOSURE
 - 2.8.1 Roller Guides
 - 2.8.2 Car Enclosure Wall Panels, Return Panels, Doors, Entrance Columns, and Transom
 - 2.8.3 Car Enclosure Top
 - 2.8.4 Car Door
 - 2.8.5 Car Entrance Sill
 - 2.8.6 Cab Finish Floor
 - 2.8.7 Car Fan
 - 2.8.8 Car Lighting
 - 2.8.9 Car Protection Pads and Hooks
- 2.9 PASSENGER ELEVATOR HOISTWAY DOORS AND ENTRANCES
 - 2.9.1 Hoistway Entrance Frames
 - 2.9.2 Hoistway Entrance Sills
 - 2.9.3 Hoistway Entrance Doors
 - 2.9.4 Hoistway Entrance Door Track Dust Covers
- 2.10 HOISTWAY EQUIPMENT
 - 2.10.1 Car Guide Rails and Fastenings
 - 2.10.2 Pit Equipment and Support Channels
 - 2.10.3 Pit "STOP" Switch
 - 2.10.4 Traveling Cables
 - 2.10.5 Hoistway Pit Ladder

PART 3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Structural Members and Finish Materials
- 3.1.2 Miscellaneous Requirements

3.2 FIELD QUALITY CONTROL

3.3 ACCEPTANCE INSPECTION, TESTING AND COMMISSIONING

- 3.3.1 Acceptance Inspection Support
- 3.3.2 Testing Materials and Instruments
- 3.3.3 Field Tests
 - 3.3.3.1 Endurance Tests
 - 3.3.3.2 Speed Tests
 - 3.3.3.3 Leveling Tests
 - 3.3.3.4 Temperature Rise Tests
 - 3.3.3.5 Motor Ampere Tests
 - 3.3.3.6 Elevator Performance and Ride Quality Testing
 - 3.3.3.7 Hydraulic Safety Valve (Automatic Shutoff Valve) Tests
 - 3.3.3.8 Hydraulic Pressure Tests
 - 3.3.3.9 Pressure Test of Liner/Cylinder Assembly

-- End of Section Table of Contents --

SECTION 14 24 23

HYDRAULIC PASSENGER ELEVATORS
05/16

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1/CSA B44	(2021) Safety Code for Elevators and Escalators
ASME A17.2	(2020) Guide for Inspection of Elevators, Escalators, and Moving Walks Includes Inspection Procedures for Electric Traction and Winding Drum Elevators, Hydraulic Elevators, and Escalators and Moving Walks
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
----------------	--

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
-------------	--

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2021) International Building Code
---------	------------------------------------

NATIONAL ELEVATOR INDUSTRY, INC. (NEII)

NEII-1 (2000; R thru 2017) Building
Transportation Standards and Guidelines,
including the Performance Standards Matrix
for New Elevator Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 70E (2021) Standard for Electrical Safety in
the Workplace

NFPA 72 (2019; TIA 19-1; ERTA 1 2019) National
Fire Alarm and Signaling Code

NFPA 101 (2021) Life Safety Code

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS SCS Global Services (SCS) Indoor Advantage

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-560-01 (2017, with Change 2, 2019) Operations and
Maintenance: Electrical Safety

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191 Americans with Disabilities Act (ADA)
Accessibility Guidelines for Buildings and
Facilities; Architectural Barriers Act
(ABA) Accessibility Guidelines

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

Elevator System; G, AE

Elevator Components; G, AE

Elevator Machine; G, AE

Elevator Controller; G, AE

Wiring Diagrams; G, AE

SD-03 Product Data

Elevator and Accessories; G, AE

Elevator Components; G, AE

Data Sheets; G, AE

Elevator Microprocessor Controller; G, AE

SD-05 Design Data

Emergency Power Systems

Heat Loads

Reaction Loads

SD-07 Certificates

Elevator Parts and Components Price Lists; G

Warranty

Endorsement Letter

Welders' Qualifications

Elevator Controller Certification; G

Indoor Air Quality for Flooring System; S

Indoor Air Quality for Adhesives; S

SD-10 Operation and Maintenance Data

Elevator, Data Package 4; G

Maintenance Control Program (MCP); G

Software and Documentation; G

Submit in accordance with Sections 01 78 23 OPERATION AND MAINTENANCE DATA and 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI).

1.2.1 Shop Drawing Requirements

Provide assembly and arrangement of elevators, accessories, and elevator components. Show location of elevator machine in elevator machine room (MR) or machinery space (MS). Show location of elevator controller in elevator machine room or elevator control room (CR). Provide details for materials and equipment, including but not limited to operating and signal fixtures, doors, door and car frames, car enclosure, controllers, motors,

guide rails and brackets, layout of hoistway in plan and elevation, and other layout information and clearance dimensions.

1.2.2 Product Data Requirements

Provide manufacturers' product data for all elevator components, including but not limited to the following: elevator controller, hydraulic pump unit, hydraulic pump and motor, hydraulic cylinder, hydraulic piping and fittings, car and hall fixture buttons and switches, cab and machine room or control room communication devices, door operator, door protection system, car roller guides, and buffers. For data sheets, provide document identification number or bulletin number, published or copyrighted prior to the date of contract bid opening. Provide controller manufacturer's published procedures for performance of each and all testing required by ASME A17.1/CSA B44.

1.2.3 Design Data

1.2.3.1 Reaction Loads

Provide calculations by registered professional engineer for reaction loads imposed on building by elevator system. Demonstrate calculations complying with ASME A17.1/CSA B44

1.2.3.2 Heat Loads

Provide calculations from elevator manufacturer, or by registered professional engineer, for total anticipated heat loads generated by all of the elevator equipment.

1.2.3.3 Emergency Power Systems

Where the facility does have an emergency power system, confirm the elevators that will be connected to the emergency power system. Confirm the complete emergency power system and sequence of operation for all elevators, including operation of the elevator lobby manual selection switch. Provide wiring diagrams for building emergency power interface with elevator controls. For elevators not supplied by an emergency power system, provide manufacturers' product data for auxiliary power systems.

1.2.4 Welders' Requirements

Comply with AWS D1.1/D1.1M, Section 5. Include certified copies of field welders' qualifications. List welders' names with corresponding code marks to identify each welder's welding work

1.2.5 Maintenance Control Program (MCP)

For each elevator, prepare and provide a written Maintenance Control Program (MCP) that complies with ASME A17.1/CSA B44 Section 8.6, including written documentation that details the test procedures for each and every test that is required to be performed by ASME A17.1/CSA B44. Assemble all MCP documentation, and supporting technical attachments, in a single MCP package and provide in both electronic and hard copy. Assemble entire hard copy MCP in 3-ring binders. For each elevator provided, the MCP must include only documentation and instruction that apply to the elevator specified.

For each elevator, provide an additional, separate binder that includes

all maintenance, repair, replacement, call back, and other records required by ASME A17.1/CSA B44. The records binder must be kept in the elevator mechanical room, maintained by elevator maintenance and service personnel, and be available at all times to authorized personnel.

Provide detailed information regarding emergency service procedures and elevator installation company personnel contact information. Provide a listing of all tools to be provided to the Contracting Officer as components of the elevator system.

1.3 QUALITY ASSURANCE

1.3.1 Qualification

Provide a designed and engineered elevator system by an elevator contractor regularly engaged in the installation of elevator systems. Provide elevator components manufactured by companies regularly engaged in the manufacture of elevator components. Utilize only licensed and certified elevator personnel for the installation, adjusting, testing, and servicing of the elevators.

1.3.1.1 Elevator Contractor's Elevator Technicians

For elevator installations in the United States, including United States territories, perform all elevator related work under the direct guidance of a state certified elevator technician with a minimum of three years of experience in the installation of elevator systems of the type and complexity specified in the contract documents. Provide an endorsement letter from the elevator manufacturer, certifying that the elevator specialist is qualified. All elevator technicians must carry a current certification issued by one of the following organizations:

- a. National Association of Elevator Contractors (NAEC)
- b. National Elevator Industry Education Program (NEIEP)

1.3.2 Manufacturers' Technical Support

Provide elevator components from manufacturers that provide factory training and online and live telephone elevator technical support to any elevator installation, service, and maintenance contractor. Provide elevator components from manufacturers that guarantee accessibility to all replacement and repair parts and components to any elevator installation, service, and maintenance contractor. Use only elevator component manufacturers that provide current published price lists for all elevator parts and components.

1.3.3 Operation and Maintenance Data

Assemble all shop drawing and product data material into O&M Data Packages in accordance with Article SUBMITTALS. Provide two complete O&M Data Packages in hard copy and two complete electronic O&M data packages on separate CDs, in PDF format. Provide all O&M Data Packages to Contracting Officer. Include controller diagnostic documentation and software as required under Article CONTROL EQUIPMENT.

1.3.4 Wiring Diagrams

Provide complete wiring diagrams and sequence of operations, which show

electrical connections and functions of elevator systems. Provide one set (11 inch by 17 inch minimum size) of wiring diagrams, with individual sheets laminated in plastic and assembled in binder, to be stored in the machine room or control room cabinet. Provide one additional hard copy set and two complete electronic sets on separate CDs, in PDF format. Provide all wiring diagram sets to the Contracting Officer. Coded diagrams are not acceptable unless fully identified.

1.3.5 Machine Room/Control Room Cabinet

For storage of O&M Data Packages and Wiring Diagrams, provide locking metal cabinet with a minimum size of 20 inch W by 12 inch D by 30 inch H. Cabinet must be sized large enough to accommodate all O&M Data and hardware required in paragraphs OPERATION AND MAINTENANCE DATA and WIRING DIAGRAMS. Secure cabinet to machine room or control room wall.

1.4 NEW INSTALLATION SERVICE

Provide elevator warranty service in accordance with the manufacturer's maintenance plan, warranty requirements and applicable safety codes, for a period of 12 months after the date of acceptance by Contracting Officer. Perform this work during regular working hours. Provide supplies and parts to keep elevator system in operation. Perform service only by factory trained personnel. Provide Monthly services to include repairs, adjustments, greasing, oiling, and cleaning. Provide service log in elevator machine room or control room and update Monthly, throughout the one-year warranty period.

Provide 24-hour emergency service, with one hour on-site response time, during this period without additional cost to the Government.

1.4.1 Periodic Elevator Certification Inspection and Testing

Provide elevator mechanic to support QEI Certified Elevator Inspector in the periodic six-month and the annual Category 1 elevator certification inspection and testing. Perform Category 1 inspection and testing no greater than 30 days prior to the end of the warranty period. Perform all elevator certification testing in the presence of QEI Certified Elevator Inspector.

In conjunction with the testing noted above, test systems for Emergency Power Operation, Earthquake Emergency Operation, and Hospital Emergency Commandeering Service Operation, as applicable. Schedule so that testing does not interfere with building operations.

1.5 FIRE PROTECTION SYSTEM

Coordinate interface between building fire protection system and elevator controls.

Additional fire protection requirements are located in: Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE; Section 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION; and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.5.1 Fire Alarm Initiating Devices

Fire alarm initiating devices are specified in Section 28 31 76 INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE , including conduit

and wiring from each detector to fire protection addressable modules in elevator machine room or control room.

1.5.2 Fire Sprinklers

Provide fire sprinklers in accordance with all applicable safety codes and with Section 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION. Provide shutoff valve, check valve, and non-adjustable, zero time-delay flow switch, in each sprinkler line immediately outside of each machine room, control room, and hoistway, as applicable. Provide inspectors' test valve for periodic testing of flow switch and shunt trip disconnect.

Pipe sprinkler piping serving these spaces in a series manner with no laterals. Locate inspectors' test connection at the end of pipe runs such that operation of the test connection will purge air from system piping.

1.5.3 Shunt Trip Disconnect

Provide flow switches specified in paragraph FIRE SPRINKLERS to comply with ASME A17.1/CSA B44 and NFPA 72 for shunt trip of the main line power supply. For each elevator, provide control wiring connecting the flow switch to a shunt trip equipped circuit breaker located in the elevator machine room or control room. Upon flow of water, flow switch will instantaneously cause opening of the shunt-trip circuit breaker and remove power from the elevator. Flow switch must also send a signal to fire alarm control panel to indicate water flow condition.

PART 2 PRODUCTS

2.1 ELEVATOR DESCRIPTION

Provide elevator system that complies with ASME A17.1/CSA B44 in its entirety, ASME A17.2 in its entirety, and additional requirements specified herein. Provide elevator system that meets or exceeds the NEII-1 Ride Quality Performance Standards Matrix (RQPSM). Comply with the RQPSM "Intermediate Performance" criteria.

Provide and install elevators in accordance with 36 CFR 1191 - ABAAS, ICC IBC, IEEE C62.41, NFPA 70 and NFPA 101 requirements.

2.1.1 Elevator Design Parameters

2.1.1.1 Elevator No.1 - Emergency Medical Service Accessibility (EMSA)

Provide elevator(s) with minimum size and arrangement to accommodate an ambulance stretcher 24-inch by 84-inch with not less than 5-inch radius corners, in the open, horizontal position.

- a. Type: Twin Jack Holeless Hydraulic
- b. Rated load: 3500 lb.
- c. Rated Speed: 100 fpm
- d. Car Door Type: Two-speed side slide.
- e. Car Door Opening Width: 4 ft.-0 in. minimum.

2.1.2 Cab Enclosure and Hoistway Entrance Assemblies

Provide finishes as listed below:

- a. Floor; luxury vinyl tile.

Provide flooring system certified to meet California Department of Public Health (CDPH) Standard Method, FLOORSCORE, UL 2818 GREENGUARD Gold, SCS Global Services Indoor Advantage Gold. Submit product data for indoor air quality for flooring system and indoor air quality for adhesives.

- b. Walls; stainless steel. Provide each cab wall with equally spaced and equally sized wall panels. All wall panel fasteners must be concealed.

Wall trim; stainless steel.

Accessories; Provide hand rails on full length of back wall and side walls of elevator cab.

- c. Car doors, car door returns, and wall reveals; stainless steel.

- d. Ceilings; supported.

Ceiling frame; stainless steel.

- e. Hoistway Entrance Assembly Material and Finishes; stainless steel.

2.2 ELEVATOR OPERATION

ASME A17.1/CSA B44, Introduction, Section 3, Definitions.

2.2.1 Single, Two-Stop, Automatic Operation

Provide Single Two-Stop Automatic Operation.

2.3 SPECIAL OPERATION AND CONTROL

Provide the following special operations and control systems.

2.3.1 Keys for Elevator Key Switches

Provide a minimum of twelve keys per unique cylinder used on all key switches for a single elevator. If there is more than one elevator, additional keys will not be required unless there are additional unique lock cylinders. Provide keys with brass or fiberglass tags marked "PROPERTY OF THE U.S. GOVERNMENT" on one side with function of key or approved code number on the other side.

2.3.2 Firefighters' Emergency Operation (FEO)

Provide FEO equipment and signaling devices. The designated level for the FEO Phase I key operated switch is the Ground (1) floor. In the FEO Phase I fixture, provide FEO Operating Instructions.

2.3.2.1 Firefighters' Emergency Operation (FEO) Key Box

Provide flush mounted, locking, FEO Key Box of a minimum size of 5 inch W by 9 inch H by 1.5 inch D. Install at a height of 6 feet above floor level and directly above the FEO Phase I key switch. Provide box equipped

with lock that uses the FEO K1 key.

2.3.3 Hoistway Access Operation

Provide hoistway access operation with switches at top and bottom terminal landings. Locate switch 6 feet above floor level, within 12 inches of elevator hoistway entrance frame or with the ferrule exposed when located in the elevator entrance frame.

2.3.4 In-Car Inspection Operation

Provide In-Car Inspection Operation.

2.3.5 Independent Service

Provide exposed key-operated switch in car operating panel to enable independent service and simultaneously disable in-car signals and landing-call responses. Provide indicator lights that automatically illuminate during independent service. For duplex or group operation, if one car is removed from group another car will respond to its hall calls.

2.3.6 Selective Door Operation

For elevator with one or more rear openings at same level as front opening, provide full-selective operation with car and door operating buttons clearly marked for front and rear openings, front and rear car button for each such floor, and front and rear "DOOR OPEN" and "DOOR CLOSE" buttons. Only door for which the button was operated opens or closes.

2.3.7 Elevator Auxiliary Power Operating System

Provide elevator auxiliary power operating system for the elevator .

2.4 ELEVATOR DRIVE SYSTEM

Provide hydraulic elevator drive system, including pump unit, piping, cylinder/plunger assembly, and associated equipment, which will operate at a maximum working pressure of 500 psi or less. Provide complete elevator system that meets or exceeds the NEII-1 Ride Quality Standard, including elevator ride quality and noise levels in car and in elevator machine room and machinery space.

2.4.1 Hydraulic Pump Unit

Provide self-contained pump unit, including oil-hydraulic elevator pump, electric motor, suction-line oil strainer, and structural steel outer base with tank supports and isolation pads. Provide oil tank capacity for full plunger displacement plus at least 10 gallons. Provide means to maintain oil temperature between 100 and 130 degrees F regardless of ambient temperature. Limit acoustic output in elevator machine room and machinery space to 80 dbA.

2.4.1.1 Pump Motor

Provide intermittent-duty pump motor rated at 120 starts/hour. Provide motor that is sized so that the motor amperage does not exceed the motor data tag amperage in any operating condition, exclusive of acceleration and deceleration. Provide minimum of one mega ohm insulation resistance

between conductors and motor frame. Provide motor and pump nameplate and data tags permanently mounted on the outside of the pump unit frame, with all data viewable without the use of mirrors or other tools.

2.4.2 Hydraulic Controls and Equipment

Provide control valve, overspeed safety valve, blowout-proof muffler, and hydraulic pump discharge strainer in the hydraulic oil supply line. Provide two 1/4 turn, ball valve type manual shutoff valves. Provide one in the elevator hoistway pit and one in the elevator machine room or machinery space.

2.4.2.1 Hydraulic Control Valve

Provide constant-velocity, down-speed regulated, control valve. Down-speed regulated control valve allows the car to travel at the same speed in the down direction, regardless of the load on the elevator. In addition, the hydraulic control valve must have built-in adjustment capability to operate the elevator at 140 percent of rated speed to facilitate periodic testing of the overspeed safety valve.

2.4.2.2 Hydraulic Overspeed Safety Valve

Provide overspeed safety valve in hydraulic oil supply line, directly adjacent to the hydraulic cylinder. Provide threaded pipe connections between the hydraulic cylinder and the overspeed valve. Provide valve equipped with manufacturer's manual shutoff feature. Overspeed valve must not be equipped with a manual or automatic lowering feature. Provide adjustable valve with means to seal adjustment after inspection and testing by certified elevator inspector.

2.4.3 Hydraulic Piping and Accessories

Provide ASTM A53/A53M or ASTM A106/A106M, Schedule 80, black steel piping with ASME B16.9 or ASME B16.11 fittings for supply piping. Extend schedule 80 piping from the pump control valve body, inside the pump unit, to the hydraulic cylinder in the hoistway. Provide welded or threaded forged pipe fittings for all fittings and components of the hydraulic oil supply line. Provide hangers or supports for all piping and components.

2.4.3.1 Containment of Hydraulic Oil Supply Line

Protect all portions of hydraulic oil supply line that are installed below ground, including portions encapsulated in concrete or covered by construction, with continuous, Schedule 80, PVC. Inside diameter of PVC must be 3 inches larger than the outside diameter of the hydraulic oil supply line pipe and couplings.

2.4.4 Hydraulic Elevator Type

Provide a holeless direct plunger type hydraulic elevator. Elevators with inverted cylinder-plungers are not acceptable and may not be used. Rope hydraulic elevator design is not acceptable and may not be used.

2.4.4.1 Cylinder-Plunger (Jack) Unit

Provide a single-stage plunger of seamless steel construction. Provide cylinder with self-stabilizing mount that will support and hold cylinder plumb without the need for stabilization means at the bottom of the

cylinder. Provide a threaded, 1/4 inch bleeder valve at the top of the cylinder, just below packing gland.

2.5 CONTROL EQUIPMENT

Enclose all elevator control equipment in factory-primed and baked-enamel coated sheet-metal cabinets with ventilation louvers and removable or hinged doors. Mount cabinets at a height of 10 inches above machine room or control room finish floor.

2.5.1 Motor Control Equipment

Provide elevator motor control with electronic, soft-start motor starter.

2.5.2 Elevator Microprocessor Controller

For each individual elevator controller, and for each group controller, provide a microprocessor controller that complies with the following paragraphs. Provide controller(s) package that includes all hardware and software required for the installation, maintenance, and service of the elevator, in its' entirety. Provide verification of technical support service that the controller manufacturer provides to any licensed elevator installation, service, and maintenance company.

Provide an elevator controller from a manufacturer that provides comprehensive factory training to include controller installation, adjustment, service, and maintenance. The training must be identified as available to any licensed elevator contractor. Provide verification of an established and documented training schedule, with pricing, for factory training classes that manufacturer has provided for a minimum period of one year prior to contract award date.

The elevator controller must be identified as available for purchase and installation by any licensed elevator contractor. All components, parts, diagnostic tools, and software must be available for purchase and installation and use by any licensed elevator contractor; "exchange-only" provisions for the purchase of spare parts are not acceptable. The elevator controller manufacturer must publish an industry competitive price listing for all controller parts, diagnostic tools, and software.

Provide verification of telephone and internet based technical support service that the elevator controller manufacturer provides to any licensed elevator installation, service, and maintenance company at an industry competitive price. The service must include live telephone based technical support for installation, adjustment, maintenance, and troubleshooting of the elevator controller and related elevator components. The service must be available during standard working hours.

Provide an elevator controller that is designed to automatically reestablish normal elevator operation following any temporary loss of power, regardless of duration.

2.5.2.1 Elevator Controller Interface Cabinet

For each individual elevator microprocessor controller, provide a separate elevator control cabinet with an integrated human interface system. For group elevator installations, a single cabinet and interface system with full access to each elevator controller may be utilized. The separate controller interface cabinet must be supplied by the elevator controller

manufacturer and include a minimum 12 inch wide keyboard and a minimum 10 inch monitor. The elevator controller interface cabinet must comply with arc-flash protection requirements of NFPA 70E and UFC 3-560-01.

2.5.2.1.1 Elevator Microprocessor Human Interface

The interface system must provide complete elevator controller interface capability and must include the elevator controller manufacturer's comprehensive package of installation and diagnostic software. The microprocessor interface system must provide unrestricted access to all parameters, all levels of adjustment, and all flags necessary for installation, adjustment, maintenance, and troubleshooting of each elevator and for the elevator group. All software programming must be stored in non-volatile memory. The elevator controller fault log must provide non-volatile memory fault log storage of all faults, trouble calls, and fault history for a minimum of one year and the ability to download or print the fault log. The controller interface must also provide the capability to display and diagnose trouble calls, faults, and shutdowns. Expiring software, degrading operation, and "key" access controls are not acceptable.

2.5.2.2 Software and Documentation

Provide three copies of the manufacturer's maintenance and service diagnostic software, with complete software documentation, that will enable the same level of unrestricted access to all controllers of the same make and model, regardless of the installation date or location. Provide signed certification, from the manufacturer's corporate headquarters, that guarantees that the microprocessor software and access system will not terminate the unlimited and unrestricted access at any future date.

2.5.2.3 Elevator Controller Certification

For elevator installations in the United States, including United States territories, provide an elevator microprocessor controller that has a current certificate of safety code compliance issued by the Technical Standards and Safety Authority (TSSA), Toronto, Canada.

2.6 OPERATING PANELS, SIGNAL FIXTURES, AND COMMUNICATIONS CABINETS

For all panels and fixtures, provide identical and uniform panel and fixture design, material, finish, and components for all elevators. For all panels and fixtures, legibly and indelibly identify all buttons, devices, and all operating positions for each device. Use engraving and backfilling, or photo etching, for button and device designations. Do not use attached signs. Provide elevator manufacturers' standard grade for all key switches unless otherwise specified. All illuminating panels and fixture components must utilize LED lighting for energy efficiency.

2.6.1 Car and Hall Buttons

For all cab and landing fixture buttons, provide industry-standard, vandal resistant push buttons with positive-stop assembly design. Buttons must be minimum 3/4 inch diameter, satin-finish stainless steel, with illuminating LED halo.

2.6.2 Passenger Car-Operating Panel

Provide each car with one car operating panel that contains operation controls and communication devices. Provide exposed, flush mounted buttons for the controls identified in subparagraph PASSENGER CONTROLS. Provide a lockable service cabinet for the controls listed in subparagraph SERVICE CONTROLS. Use engraving and backfilling or photo etching for button and switch designations. Do not use attached signs.

2.6.2.1 Passenger Controls

In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:

- a. Illuminating car-call buttons identified to correspond to landings served by the elevator.
- b. "DOOR OPEN" and "DOOR CLOSE" buttons. For front and rear openings at the same floor, include the identification "F" and "R" for each opening.
- c. Red, illuminating "ALARM" button.
- d. Key-operated "Independent Service" switch.
- e. "Help" communication device to include communication between elevator cab and elevator machine room or control room.
- f. Key-operated "HOSPITAL EMERGENCY COMMANDEERING SERVICE" switch.

2.6.2.2 Service Controls

In addition to ASME A17.1/CSA B44 requirements, provide the following operating controls, identified as indicated:

- a. Provide a key-operated, three-position switch for "In car Inspection Operation" and "Hoistway Access". The center switch position will provide normal, automatic operation.
- b. "Car Light" switch.
- c. "Car Fan" switch with two speed settings identified.
- d. 120-volt ac 60 Hz single-phase duplex electrical outlet of ground-fault-circuit-interrupt (GFCI) design.

2.6.2.3 Certificate Window

Provide a minimum 4 inch wide by 6 inch high certificate window for elevator inspection certificate. Locate window in the Service Controls door of the Car Operating Panel.

2.6.2.4 Emergency Signaling Devices

Provide an audible signaling device, operable from the Car Operating Panel button marked "ALARM". The audible signaling device must have a sound pressure rating between 80 and 90 dBA at 10 ft. Provide battery backup power capable of operating the audible signaling device for at least one hour.

2.6.3 Elevator In-Car Position Indicators

For all elevators, provide illuminating position indicator in the Car Operating Panel.

2.6.4 Elevator In-Car Direction Indicators

For 2-stop elevator installations, provide visual direction indicators and audible car arrival signal in the elevator car door jamb, in accordance with ABA Standards. Visual indicators must be visible from the hall call fixture.

2.6.5 Hall Call Landing Fixtures

Provide a hall call fixture adjacent to each elevator. Provide a single push-button for terminal landings and dual push-buttons, up and down, at intermediate landings.

2.6.5.1 Designated Landing Hall Call Fixture

2.6.5.1.1 Location of COMMUNICATION MEANS FAILURE (CMF) Visual Signal

When required by ASME A17.1/CSA B44, provide an elevator CMF audible and illuminating signal, and reset switch, in the FEO Designated Landing hall call fixture. Mount the signal and reset switch at a minimum of 7 inches above the "UP" hall call button.

2.6.5.1.2 COMMUNICATION MEANS FAILURE (CMF) Visual and Audible Signal Operation

Provide a CMF visual and audible signal system that conforms to ASME A17.1/CSA B44. Provide continuous verification of operability of the telephone line and immediate activation of audible and visual signals when verification means determines that the telephone line is not functioning. Provide illumination of visual signal at one second intervals. Provide a minimum of 65 dBA audible signal at 30 second intervals.

2.6.5.1.3 Firefighters' Emergency Operation Phase I Switch and Visual Signal

When required by ASME A17.1/CSA B44, provide an elevator Firefighters' Emergency Operation Phase I switch and illuminating visual signal in the FEO Designated Landing hall call fixture. Provide FEO Phase I visual signal that is designed with intermittent, flashing, illumination when actuated by the machine room, control room, or hoistway fire alarm initiating device. Locate FEO Phase I key switch above the CMF visual signal with a minimum of 6 inches vertical between the centerlines of the CMF signal and the FEO Phase I key switch. Locate FEO Phase I visual signal directly above the Phase I switch. In addition, locate Elevator Corridor Call Station Pictograph at top of hall call fixture.

2.6.6 Elevator Car Position and Direction Indicators and Car Arrival Signal

For elevator installations with three or more stops, provide a separate hall landing fixture that includes the visual elevator position indicator, visual direction indicators, and audible car arrival signal, in accordance with ABA Standards.

2.6.7 Designated Landing Elevator Identification Fixture

For duplex and group elevator installations, provide a separate elevator identification fixture for each elevator, with identification engraved and backfilled with a contrasting color. Number elevators from left to right, as seen during primary approach from building main entrance to elevator lobby. For multiple elevator groups, begin numbering with group that is closest to the building main entrance.

2.6.8 Emergency or Standby Power

When emergency or standby power is provided for elevator operation, provide an elevator emergency power visual indicator that conforms to ASME A17.1/CSA B44. Locate the visual signal in the Firefighters Emergency Operation fixture for each simplex elevator and for each elevator group. When an emergency power selector switch is required, provide switch in a separate, flush mounted fixture located at the designated level, in view of all elevator entrances.

2.7 CAR DOOR EQUIPMENT

2.7.1 Car Door Operator

Provide elevator door operator equipment and circuitry that is designed and installed as discreet communication. Serial communication must not be used for this system.

2.7.2 Infra-red Curtain Unit

Provide Infra-red Curtain Unit (ICU) with multiple infra-red beams that protect to the full height and width of the door opening. Provide door nudging operation.

2.8 PASSENGER ELEVATOR GUIDES, PLATFORM, AND ENCLOSURE

2.8.1 Roller Guides

Provide coil-spring loaded roller guide assemblies in adjustable mountings on each side of car and counterweight frames in accurate alignment at top and bottom of frames.

2.8.2 Car Enclosure Wall Panels, Return Panels, Doors, Entrance Columns, and Transom

Provide cab wall panels and entrance components as indicated. Apply sound-deadening material on exterior of all cab wall panels.

2.8.3 Car Enclosure Top

Provide reinforced, 12 gauge minimum steel car enclosure top. Provide hinged emergency exit with lock that complies with the seismic risk zone 2 or greater design requirements of ASME A17.1/CSA B44. Locate emergency exit hinge towards the rear of the elevator cab. Design and configure the elevator cab interior ceiling to provide convenient and unobstructed access to, and use of, emergency exit from inside the elevator cab.

2.8.4 Car Door

Provide 16 gauge minimum stainless steel car doors of sandwich

construction with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading and one at trailing door edge with guides in the sill groove their entire length of travel.

2.8.5 Car Entrance Sill

Provide one piece cast nickel silver, stainless steel, or white bronze entrance sill(s). Set sills level and flush with floor finish. Use same material for hoistway and car entrance sills.

2.8.6 Cab Finish Floor

Provide cab finish floor as indicated with top of finish floor flush with the cab sill.

2.8.7 Car Fan

Provide 2-speed fan for car enclosure forced ventilation. Fan must be mounted in the car enclosure top.

2.8.8 Car Lighting

Utilize LED lighting for elevator car interior illumination. Provide a minimum of 10 foot-candles, measured at all areas of the car enclosure floor. Provide automatic car lighting operation that will turn off car lights after 3 minutes of inactivity. Car lights must automatically turn on upon actuation of an elevator car or hall call.

2.8.9 Car Protection Pads and Hooks

Provide fire retardant, hanging car protection pads that provide protection for all car interior wall panels. Provide permanently installed studs in car that are designed for hanging the car protection pads in the car.

2.9 PASSENGER ELEVATOR HOISTWAY DOORS AND ENTRANCES

Provide hoistway entrance assemblies with a minimum 1-1/2 hour fire rating. Use same material and finish for all hoistway and car entrance assemblies.

2.9.1 Hoistway Entrance Frames

Provide 14 gage minimum stainless steel hoistway entrance frames. Solidly grout uprights of entrance ways to height of 5 feet.

2.9.2 Hoistway Entrance Sills

Provide one-piece cast nickel silver, stainless steel, or white bronze entrance sills. Set top of landing sill flush with top of finish floor. Solidly grout under full length of sill. Use same material for all hoistway and car entrance sills.

2.9.3 Hoistway Entrance Doors

Provide stainless steel non-vision construction hoistway entrance doors with flush surfaces on car and landing sides. Provide a minimum of 2 door guide assemblies per door panel, one guide at leading edge and one at

trailing edge with guides in the sill groove the entire length of door travel. Use same material and finish for all hoistway and car entrance assemblies.

2.9.4 Hoistway Entrance Door Track Dust Covers

Provide sheet metal hoistway door track dust covers at each landing. Dust covers must cover top and hoistway side of door locks and door roller tracks, and extend the full width of the door track and associated hardware. Dust cover sections will not exceed 3 feet in length.

2.10 HOISTWAY EQUIPMENT

2.10.1 Car Guide Rails and Fastenings

Provide T-section type guide rails for car. Paint rail shanks with one coat of black enamel.

2.10.2 Pit Equipment and Support Channels

Provide rail-to-rail pit channels to serve as mounting surface for main guide rails and car buffers. Method of installation of channels, brackets and buffer mounts must be such that pit waterproofing is not punctured.

2.10.3 Pit "STOP" Switch

Provide push-to-stop/pull-to-run type pit "STOP" switch.

2.10.4 Traveling Cables

Suspend traveling cables by means of self-tightening webbed devices or internal suspension members.

2.10.5 Hoistway Pit Ladder

Provide continuous horizontal rungs for the full height of the pit ladder.

PART 3 EXECUTION

3.1 INSTALLATION

Install in accordance with DOD design criteria, contract specifications, manufacturer's instructions, NEII-1 Building Transportation Standards and Guidelines, and all applicable building and safety code requirements.

3.1.1 Structural Members and Finish Materials

Do not cut or alter structural members. Do not alter finish materials from manufacturer's original design. Restore any damaged or defaced work to original condition.

3.1.2 Miscellaneous Requirements

Provide recesses, cutouts, slots, holes, patching, grouting, and refinishing to accommodate elevator installation. Use core drilling to drill all new holes in concrete. Finish work to be straight, level, and plumb. During installation, protect machinery and equipment from dirt, water, or mechanical damage. At completion, clean all work and spot paint.

3.2 FIELD QUALITY CONTROL

The Contractor will provide and utilize a third-party licensed and certified Qualified Elevator Inspector (QEI) to conduct elevator pre-acceptance inspection and testing. The QEI must perform inspections and witness tests to ensure that the installation conforms to all applicable safety codes and contract requirements. The QEI will be directly employed by the Contractor and independent of the elevator contractor.

Upon completion, the QEI must provide written test data for all ASME A17.1/CSA B44 Acceptance Tests and written certification that the elevator is complete and ready for final Acceptance Inspection, Testing, and Commissioning.

3.3 ACCEPTANCE INSPECTION, TESTING AND COMMISSIONING

When elevator system installation is complete and ready for final inspection, notify Contracting Officer that elevator system is ready for Acceptance Inspection, Testing, and Commissioning. Provide QEI certification specified in Article FIELD QUALITY CONTROL.

Contracting Officer will obtain the services of a third-party QEI Certified Elevator Inspector. The QEI must utilize an Elevator Acceptance Inspection Form to record the results of inspection and all testing and to identify safety code and contract deficiencies. Specific values must be provided for all tests required by ASME A17.1/CSA B44, ASME A17.2, and contract documents. Upon completion of inspection and testing, the QEI must sign a copy of the completed forms and provide to the Contracting Officer. Within 2 weeks of the inspection, the QEI must also prepare a formal inspection report, including all test results and deficiencies. Upon successful completion of inspection and testing, the QEI will complete, sign, and provide a certificate of compliance with ASME A17.1/CSA B44.

3.3.1 Acceptance Inspection Support

Prime and Elevator Contractors must provide inspection support and perform all required tests, in order to demonstrate proper operation of each elevator system and to prove that each system complies with contract requirements and all applicable building and safety codes. Inspection procedures in ASME A17.2 form a part of this inspection and acceptance testing. All inspection and testing must be conducted in the presence of the Qualified Elevator Inspector (QEI).

If the elevator does not comply with all contract and safety code requirements on the initial Acceptance Inspection and Test, the Contractor is responsible for all costs involved with re-inspection and re-testing required as a result of contractor delays and discrepancies discovered during inspection and testing.

3.3.2 Testing Materials and Instruments

Furnish all testing materials and instruments necessary for Acceptance Inspection, Testing and Commissioning. At a minimum, include calibrated test weights, tachometer, accelerometer, hydraulic pressure gauge, 600-volt mega ohm meter, volt meter and ammeter, infrared temperature gauge, door pressure gage, dynamometer, and 20 foot tape measure.

3.3.3 Field Tests

3.3.3.1 Endurance Tests

Test each elevator for a period of one hour continuous, automatic operation, with specified rated load in the elevator cab. During the one hour test, stop car at each floor, in both directions of travel, and allow automatic door open and close operation. The requirements for Automatic Operation, Rated Speed, Leveling, Temperature Rise and Motor Amperes must be met throughout the duration of the Endurance Test. Restart the one hour test period from the beginning, following any shutdown or failure.

3.3.3.2 Speed Tests

Determine actual speed of each elevator, in both directions of travel, with rated load and with no load in elevator car. Make Speed tests at the beginning and at the end of the Endurance test. Determine speed by tachometer reading or accelerometer, excluding accelerating and slow-down zones. Under all conditions, minimum acceptable elevator speed is the Rated speed specified. Maximum acceptable elevator speed is 110 percent of Rated speed.

3.3.3.3 Leveling Tests

Test elevator car leveling operation and provide a leveling accuracy equal to or less than 1/8 inch at each floor with no load in car, and with rated load in car, in both directions of travel. Determine leveling accuracy at the beginning and at the end of the endurance tests.

3.3.3.4 Temperature Rise Tests

Determine temperature rise of elevator pump motor and hydraulic fluid during one-hour full-load test run. Under these conditions, maximum temperature rise must not exceed acceptable temperature rise indicated on manufacturer's data plate. Start test only when equipment is within 5 degrees C of ambient temperature.

3.3.3.5 Motor Ampere Tests

At beginning and end of Endurance test, measure and record motor amperage in both directions of travel and in both no-load and rated load conditions.

3.3.3.6 Elevator Performance and Ride Quality Testing

Evaluate elevator performance to ensure compliance with specification requirements related to the NEII-1 Performance Standards Matrix for New Elevator Installations.

3.3.3.7 Hydraulic Safety Valve (Automatic Shutoff Valve) Tests

In order to ensure consistent performance, regardless of hydraulic oil temperature, test the Hydraulic Safety Valve twice. Test once before the one-hour endurance test and once immediately after the one-hour test. For elevator certification, safety valve must perform to code in both tests.

3.3.3.8 Hydraulic Pressure Tests

Check the hydraulic static pressure and rated-speed operating pressure at the hydraulic control valve, under both no load and rated load conditions.

3.3.3.9 Pressure Test of Liner/Cylinder Assembly

Perform 20 psig pressure test of the completed and installed liner/cylinder assembly. Test liner/cylinder assembly as a sealed unit. Provide safety relief valve set to relieve at 20 psig; 4.5 inch diameter dial pressure gage scaled for 0 to 50 psig and calibrated to 0.5 percent accuracy; and an air pressure admission throttle and shutoff valve. For safety, pressure test must only be performed when liner and cylinder are fully inserted and assembled in the well casing. Perform the test from remote location outside of the elevator pit. Perform test in the presence of, and witnessed by, a Certified Elevator Inspector.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 21 - FIRE SUPPRESSION

SECTION 21 13 13

WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
 - 1.2.1 Hydraulic Design
 - 1.2.1.1 Basis for Calculations
 - 1.2.1.2 Hydraulic Calculations
 - 1.2.1.3 Design Criteria
 - 1.2.2 Sprinkler Coverage
 - 1.2.3 Qualified Fire Protection Engineer (QFPE)
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Preconstruction Submittals
 - 1.4.1.1 Shop Drawing
 - 1.4.1.2 Product Data
 - 1.4.1.3 Hydraulic Calculations
 - 1.4.1.4 Operating and Maintenance (O&M) Instructions
 - 1.4.2 Qualifications
 - 1.4.2.1 Sprinkler System Designer
 - 1.4.2.2 Sprinkler System Installer
 - 1.4.3 Regulatory Requirements
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 EXTRA MATERIALS

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
 - 2.1.1 Standard Products
 - 2.1.2 Nameplates
 - 2.1.3 Identification and Marking
 - 2.1.4 Pressure Ratings
- 2.2 UNDERGROUND PIPING COMPONENTS
 - 2.2.1 Pipe
 - 2.2.2 Fittings and Gaskets
 - 2.2.3 Buried Utility Warning and Identification Tape
- 2.3 ABOVEGROUND PIPING COMPONENTS
 - 2.3.1 Steel Piping Components
 - 2.3.1.1 Steel Pipe
 - 2.3.1.2 Fittings
 - 2.3.1.3 Grooved Mechanical Joints and Fittings
 - 2.3.1.4 Flanges
 - 2.3.2 Flexible Sprinkler Hose
 - 2.3.3 Pipe Hangers and Supports
 - 2.3.4 Valves
 - 2.3.4.1 Control Valve
 - 2.3.4.2 Check Valves

- 2.3.4.3 Hose Valve
- 2.3.5 Riser Check Valves
- 2.4 ALARM INITIATING AND SUPERVISORY DEVICES
 - 2.4.1 Sprinkler Alarm Switch
 - 2.4.2 Valve Supervisory (Tamper) Switch
- 2.5 BACKFLOW PREVENTION ASSEMBLY
 - 2.5.1 Backflow Preventer Test Connection
- 2.6 FIRE DEPARTMENT CONNECTION
- 2.7 SPRINKLERS
 - 2.7.1 Pendent Sprinkler
 - 2.7.2 Upright Sprinkler
 - 2.7.3 Sidewall Sprinkler
- 2.8 ACCESSORIES
 - 2.8.1 Sprinkler Cabinet
 - 2.8.2 Pendent Sprinkler Escutcheon
 - 2.8.3 Pipe Escutcheon
 - 2.8.4 Sprinkler Guard
 - 2.8.5 Relief Valve
 - 2.8.6 Air Vent
 - 2.8.7 Identification Sign

PART 3 EXECUTION

- 3.1 VERIFYING ACTUAL FIELD CONDITIONS
- 3.2 INSTALLATION
 - 3.2.1 Waste Removal
- 3.3 UNDERGROUND PIPING INSTALLATION
- 3.4 ABOVEGROUND PIPING INSTALLATION
 - 3.4.1 Protection of Piping Against Earthquake Damage
 - 3.4.2 Piping in Exposed Areas
 - 3.4.3 Piping in Finished Areas
 - 3.4.4 Pendent Sprinklers
 - 3.4.5 Upright Sprinklers
 - 3.4.6 Pipe Joints
 - 3.4.7 Reducers
 - 3.4.8 Pipe Penetrations
 - 3.4.9 Escutcheons
 - 3.4.10 Inspector's Test Connection
 - 3.4.11 Backflow Preventer
 - 3.4.11.1 Test Connection
 - 3.4.12 Drains
 - 3.4.13 Installation of Fire Department Connection
 - 3.4.14 Identification Signs
- 3.5 ELECTRICAL
- 3.6 PAINTING
- 3.7 FIELD QUALITY CONTROL
 - 3.7.1 Test Procedures
 - 3.7.2 Pre-Government Testing
 - 3.7.2.1 Verification of Compliant Installation
 - 3.7.2.2 Request for Government Final Test
 - 3.7.3 Correction of Deficiencies
 - 3.7.4 Government Final Tests
- 3.8 MINIMUM SYSTEM TESTS
 - 3.8.1 Underground Piping
 - 3.8.1.1 Flushing
 - 3.8.1.2 Hydrostatic Test
 - 3.8.2 Aboveground Piping
 - 3.8.2.1 Hydrostatic Test
 - 3.8.2.2 Backflow Prevention Assembly Forward Flow Test

- 3.8.3 Main Drain Flow Test
- 3.9 SYSTEM ACCEPTANCE
- 3.10 ONSITE TRAINING

-- End of Section Table of Contents --

SECTION 21 13 13

WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION
08/20

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.21	(2021) Nonmetallic Flat Gaskets for Pipe Flanges

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)
ASSE 1015	(2011) Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies - (ANSI approved 2010)

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C203	(2020) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA M14 (2015) Manual: Recommended Practice for Backflow Prevention and Cross-Connection Control

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M (1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings

ASTM A53/A53M (2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A135/A135M (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 (2019; Errata 19-1; Errata 19-2; TIA 19-1; TIA 19-2; TIA 19-3; TIA 19-4; Errata 19-3; Errata 20-4; TIA 19-5; TIA 19-6) Standard for the Installation of Sprinkler Systems

NFPA 24 (2019; TIA 19-1) Standard for the Installation of Private Fire Service Mains and Their Appurtenances

NFPA 291 (2016) Recommended Practice for Fire Flow Testing and Marking of Hydrants

NFPA 1963 (2019) Standard for Fire Hose Connections

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 (2010; Reprint Mar 2018) UL Standard for
Safety Check Valves for Fire-Protection
Service

UL 405 (2013; Bul. 2020) UL Standard for Safety
Fire Department Connection Devices

UL 668 (2004; Reprint Jul 2016) UL Standard for
Safety Hose Valves for Fire-Protection
Service

UL Fire Prot Dir (2012) Fire Protection Equipment Directory

1.2 SYSTEM DESCRIPTION

Provide wet pipe sprinkler system(s) in all areas of the building. 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 December 2, 2020 at Hydrants WAFH 1-19 & 1-18 and resulted in a static pressure of 84 psi with a residual pressure of 65 psi while flowing 2,226 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 upon the Hazen-Williams formula with a "C" value noted in NFPA 13 for piping..

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 250 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 building. 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 information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Partial submittals and submittals not fully complying with 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

Sprinkler System Designer; G

Sprinkler System Installer; G

SD-02 Shop Drawings

Shop Drawing; G

SD-03 Product Data

Pipe; G

Fittings; G

Valves, including gate, check, butterfly, and globe; G

Riser check Valves; G

Relief Valves; G

Sprinklers; G

Pipe Hangers and Supports; G

Sprinkler Alarm Switch; G

Valve Supervisory (Tamper) Switch; G

Fire Department Connection; G

Backflow Prevention Assembly; G

Air Vent; G

Hose Valve; G

Seismic Bracing; G

Nameplates; G

SD-05 Design Data

Seismic Bracing; G

Load calculations for sizing of seismic bracing

Hydraulic Calculations; G

SD-06 Test Reports

Test Procedures; G

SD-07 Certificates

Verification of Compliant Installation; G

Request for Government Final Test; G

SD-10 Operation and Maintenance Data

Operating and Maintenance (O&M) Instructions; G

Spare Parts Data; G

SD-11 Closeout Submittals

As-built drawings

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

Five 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, sway bracing for earthquake protection, 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, seismic bracing/restraint and related components.

1.4.1.2 Product Data

Five 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.

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. 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 (min) 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 175 psi.

2.2 UNDERGROUND PIPING COMPONENTS

2.2.1 Pipe

Pipe must comply with NFPA 24. Minimum pipe size is 6 inches. Piping more than 5 feet outside the building walls must comply with Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING. A continuous section of welded stainless steel fire water service piping from a point outside the building perimeter to a flanged fitting at least 1-foot above the finished floor within the building is acceptable.

2.2.2 Fittings and Gaskets

Fittings must be ductile-iron conforming to AWWA C110/A21.10 with cement mortar lining conforming to AWWA C104/A21.4. Gaskets must be suitable in

design and size for the pipe with which such gaskets are to be used. Gaskets for ductile-iron pipe joints must conform to AWWA C111/A21.11.

2.2.3 Buried Utility Warning and Identification Tape

Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape must be detectable by an electronic detection instrument. Provide tape, 3 inches minimum width, color coded for the utility involved with warning and identification imprinted in bold block letters continuously and repeatedly over the entire tape length. Warning and identification must read "CAUTION BURIED WATER PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.3 ABOVEGROUND PIPING COMPONENTS

2.3.1 Steel Piping Components

2.3.1.1 Steel Pipe

Except as modified herein, steel pipe must be black as permitted by NFPA 13 and conform to the applicable provisions of ASTM A53/A53M, ASTM A135/A135M or ASTM A153/A153M.

Steel pipe must be minimum Schedule 40 for sizes 2 inches and less; and minimum Schedule 10 for sizes larger than 2 inches. Steel piping with wall thickness less than Schedule 40 must not be threaded.

2.3.1.2 Fittings

Fittings must be welded, threaded, or grooved-end type. Threaded fittings must be cast-iron conforming to ASME B16.4, malleable-iron conforming to ASME B16.3 or ductile-iron conforming to ASTM A536. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe, saddle tees using rubber gasketed fittings, steel press fittings and field welded fittings are not permitted. Fittings, mechanical couplings, and rubber gaskets must be supplied by the same manufacturer. Threaded fittings must use Teflon tape or manufacturer's approved joint compound. Reducing couplings are not permitted except as allowed by NFPA 13.

2.3.1.3 Grooved Mechanical Joints and Fittings

Joints and fittings must be designed for not less than 175 psi service and the product of the same manufacturer. Field welded fittings must not be used. Fitting and coupling housing must be malleable-iron conforming to ASTM A47/A47M, Grade 32510; ductile-iron conforming to ASTM A536, Grade 65-45-12. Rubber gasketed grooved-end pipe and fittings with mechanical couplings are permitted in pipe sizes 2 inches and larger. Gasket must be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts must be heat-treated steel conforming to ASTM A183 and must be cadmium-plated or zinc-electroplated.

2.3.1.4 Flanges

Flanges must conform to NFPA 13 and ASME B16.1. Gaskets must be non-asbestos compressed material in accordance with ASME B16.21, 1/16-inch thick, and full face or self-centering flat ring type.

2.3.2 Flexible Sprinkler Hose

The use of flexible hose is not permitted.

2.3.3 Pipe Hangers and Supports

Provide galvanized pipe hangers, supports and seismic bracing and supports in accordance with NFPA 13..

2.3.4 Valves

Provide valves of types approved for fire service. Valves must open by counterclockwise rotation.

2.3.4.1 Control Valve

Manually operated sprinkler control/gate valve must be outside stem and yoke (OS&Y) type or butterfly type and must be listed.

2.3.4.2 Check Valves

Check valves must comply with UL 312. Check valves 4 inches and larger must be of the swing type, have a clear waterway and meet the requirements of MSS SP-71, for Type 3 or 4. Inspection plate must be provided on valves larger than 6 inches.

2.3.4.3 Hose Valve

Valve must comply with UL 668.

2.3.5 Riser Check Valves

Provide riser check valve, pressure gauges and main drain.

2.4 ALARM INITIATING AND SUPERVISORY DEVICES

2.4.1 Sprinkler Alarm Switch

Vane or pressure-type flow switch(es). Connection of switch must be by the fire alarm installer. Vane type alarm actuating devices must have mechanical diaphragm controlled retard device adjustable from 10 to 60 seconds and must instantly recycle. Flow switches for elevator power shunt must not have a retard feature.

2.4.2 Valve Supervisory (Tamper) Switch

Switch must be integral to the control valve or suitable for mounting to the type of control valve to be supervised open. The switch must be tamper resistant and contain SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.5 BACKFLOW PREVENTION ASSEMBLY

Double-check valve assembly backflow preventer complying with ASSE 1013, ASSE 1015 and AWWA M14. Each check valve must have a drain. Backflow prevention assemblies must have current "Certificate of Approval from the Foundation for Cross-Connection Control and Hydraulic Research, FCCCHR

List" and be listed for fire protection use. Listing of the specific make, model, design, and size in the FCCCHR List is acceptable as the required documentation.

2.5.1 Backflow Preventer Test Connection

Test connection must consist of a series of listed hose valves with 2 1/2-inch National Standard male hose threads with cap and chain.

2.6 FIRE DEPARTMENT CONNECTION

Fire department connection must be projecting type with cast-brass body, matching wall escutcheon lettered "Auto Spkr" with a polished-brass finish. The connection must have individual self-closing clappers, caps with drip drains and chains. Female inlets must have 2 1/2-inch diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963. Comply with UL 405.

2.7 SPRINKLERS

Sprinklers must comply with UL 199 and NFPA 13. Sprinklers with internal O-rings are not acceptable. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters must have temperature classification in accordance with NFPA 13. Extended coverage sprinklers are permitted for loading docks, residential occupancies and high-piled storage applications only.

2.7.1 Pendent Sprinkler

Pendent sprinkler must be recessed quick-response type with nominal K-factor of 5.6 or 8.0. Pendent sprinklers must have a polished chrome finish. Assembly must include an integral escutcheon.

2.7.2 Upright Sprinkler

Upright sprinkler must be brass quick-response type and have a nominal K-factor of 5.6 or 8.0.

2.7.3 Sidewall Sprinkler

Sidewall sprinkler must be the quick-response type. Sidewall sprinkler must have a nominal K-factor of 5.6 or 8.0. Sidewall sprinkler must have a polished-chrome finish.

2.8 ACCESSORIES

2.8.1 Sprinkler Cabinet

Provide spare sprinklers in accordance with NFPA 13 and must be placed in a suitable metal or plastic cabinet of sufficient size to accommodate all the spare sprinklers and wrenches in designated locations. Spare sprinklers must be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed as required by NFPA 13. At least one wrench of each type required must be provided.

2.8.2 Pendent Sprinkler Escutcheon

Escutcheon must be one-piece metallic type with a depth of less than 3/4-inch and suitable for installation on pendent sprinklers. The

escutcheon must have a factory finish that matches the pendent sprinkler.

2.8.3 Pipe Escutcheon

Provide split hinge metal plates for piping entering walls, floors, and ceilings in exposed spaces. Provide polished stainless steel plates or chromium-plated finish on copper alloy plates in finished spaces. Provide paint finish on metal plates in unfinished spaces.

2.8.4 Sprinkler Guard

Listed guard must be a steel wire cage designed to encase the sprinkler and protect it from mechanical damage. Guards must be provided on sprinklers located where susceptible to physical damage or within 7 feet of the floor.

2.8.5 Relief Valve

Relief valves must be listed and installed at the riser in accordance with NFPA 13.

2.8.6 Air Vent

Air vents must be of the automatic type and piped to drain to the building exterior.

2.8.7 Identification Sign

Valve identification sign must be minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gage steel or 0.024-inch aluminum with red letters on a white background or white letters on red background. Wording of sign must include, but not be limited to "main drain", "auxiliary drain", "inspector's test", "alarm test", "alarm line", and similar wording as required to identify operational components. Where there is more than one sprinkler system, signage must include specific details as to the respective system.

PART 3 EXECUTION

3.1 VERIFYING ACTUAL FIELD CONDITIONS

Before commencing work, examine all adjoining work on which the contractor's work that is dependent for perfect workmanship according to the intent of this specification section, and report to the Contracting Officer's Representative a condition that prevents performance of first class work. No "waiver of responsibility" for incomplete, inadequate or defective adjoining work will be considered unless notice has been filed before submittal of a proposal.

3.2 INSTALLATION

The installation must be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Locate sprinklers in a consistent pattern with ceiling grid, lights, and air supply diffusers. Install sprinkler system over and under ducts, piping and platforms when such equipment can negatively affect or disrupt the sprinkler discharge pattern and coverage.

- a. Piping offsets, fittings, and other accessories required must be

furnished to provide a complete installation and to eliminate interference with other construction.

- b. Wherever the contractor's work interconnects with work of other trades the Contractor must coordinate with other Contractors to insure all Contractors have the information necessary so that they may properly install all necessary connections and equipment. Identify all work items needing access (dampers and similar equipment) that are concealed above hung ceilings by permanent color coded pins/tabs in the ceiling directly below the item.
- c. Provide required supports and hangers for piping, conduit, and equipment so that loading will not exceed allowable loadings of structure. Submittal of a bid must be a deemed representation that the contractor submitting such bid has ascertained allowable loadings and has included in his estimates the costs associated in furnishing required supports.

3.2.1 Waste Removal

At the conclusion of each day's work, clean up and stockpile on site all waste, debris, and trash which may have accumulated during the day as a result of work by the contractor and of his presence on the job. Sidewalks and streets adjoining the property must be kept broom clean and free of waste, debris, trash and obstructions caused by work of the contractor, which will affect the condition and safety of streets, walks, utilities, and property.

3.3 UNDERGROUND PIPING INSTALLATION

The fire protection water main must be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover must be 5 feet or the frost line, whichever is deeper. The supply line must terminate inside the building with a flanged piece, the bottom of which must be set not less than 1-foot above the finished floor. A blind flange must be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block must be provided at the elbow where the pipe turns up toward the floor. In addition, joints must be anchored in accordance with NFPA 24. Buried steel components must be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 5 feet outside the building walls must meet the requirements of Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

3.4 ABOVEGROUND PIPING INSTALLATION

The methods of fabrication and installation of the aboveground piping must fully comply with the requirements and recommended practices of NFPA 13 and this specification section.

3.4.1 Protection of Piping Against Earthquake Damage

Seismic restraint is required.

3.4.2 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.

3.4.3 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.

3.4.4 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.

3.4.5 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.

3.4.6 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.

3.4.7 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.

3.4.8 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.

3.4.9 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.

3.4.10 Inspector's Test Connection

Unless otherwise indicated, the test connection must consist of 1-inch pipe connected at the riser as a combination test and drain valve; a test valve located approximately 7 feet above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test". All test connection piping must be inside of the building and penetrate the exterior wall at the location of the discharge orifice only. The discharge orifice must be located outside the building wall no more than 2 feet above finished grade, directed so as not to cause damage to adjacent construction or landscaping during full flow discharge, or to the sanitary sewer. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building. Do not discharge to the roof. Discharge to floor drains, janitor sinks or similar fixtures is not permitted.

Provide concrete splash blocks at all drain and inspector's test connection discharge locations if not discharging to a concrete surface. Splash blocks must be large enough to mitigate erosion and not become dislodged during a full flow of the drain. Ensure all discharged water drains away from the facility and does not cause property damage.

3.4.11 Backflow Preventer

Locate within the building or in a heated enclosure in locations subject to freezing. For heated enclosures, provide a low temperature supervisory alarm connected to the facility fire alarm system. Heat trace is not permitted to be used.

Install backflow preventers so that the bottom of the assembly is a minimum of 6 inches above the finished floor/grade. Install horizontal backflow preventers so that the bottom of the assembly is no greater than 24 inches above the finished floor/grade. Install vertical backflow preventers so that the upper operating handwheel is no more than 6 feet above the finished floor/grade. Clearance around control valve handles must be minimum 6 inches above grade/finished floor and away from walls.

3.4.11.1 Test Connection

Provide downstream of the backflow prevention assembly UL 668 hose valves with 2.5-inch National Standard male hose threads with cap and chain. Provide one valve for each 250 gpm of system demand or fraction thereof. Provide a permanent sign in accordance with paragraph entitled "Identification Signs" which reads, "Test Valve". Indicate location of test header. If an exterior connection, provide a control valve inside a heated mechanical room to prevent freezing.

3.4.12 Drains

- a. Main drain piping must be provided to discharge at a safe point outside the building, no more than 2 feet above finished grade. Provide a concrete splash block at drain outlet. Discharge to the exterior must not interfere with exiting from the facility. Water discharge or runoff must not cross the path of egress from the building.
- b. Auxiliary drains must be provided as required by NFPA 13. Auxiliary drains are permitted to discharge to a floor drain if the drain is sized to accommodate full flow (min 40 gpm). Discharge to service sinks or similar plumbing fixtures is not permitted.

3.4.13 Installation of Fire Department Connection

Connection must be mounted on the exterior wall approximately 3 feet above finished grade. The piping between the connection and the check valve must be provided with an automatic drip in accordance with NFPA 13 and piped to drain to the outside or a floor drain within the same room.

3.4.14 Identification Signs

Signs must be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Main drain test results must be etched into main drain identification sign. Hydraulic design data must be etched into the nameplates and permanently affixed to each sprinkler riser as specified in

NFPA 13. Provide labeling on the surfaces of all feed and cross mains to show the pipe function (e.g., "Sprinkler System", "Fire Department Connection", "Standpipe") and normal valve position (e.g. "Normally Open", "Normally Closed"). For pipe sizes 4-inch and larger provide white painted stenciled letters and arrows, a minimum of 2 inches in height and visible from at least two sides when viewed from the floor. For pipe sizes less than 4-inch, provide white painted stenciled letters and arrows, a minimum of 0.75-inch in height and visible from the floor. Provide properly lettered and approved metal sign to elevator flow switch stating the circuits' voltage, and identify the switch as an "Elevator Power Shunt Flow Switch".

3.5 ELECTRICAL

Except as modified herein, electric equipment and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Alarm signal wiring connected to the building fire alarm control system must be by the fire alarm installer.

3.6 PAINTING

Color code mark piping red as specified in Section 09 90 00 PAINTS AND COATINGS.

3.7 FIELD QUALITY CONTROL

3.7.1 Test Procedures

Submit detailed test procedures, prepared and signed by the NICET Level III 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.

3.7.2 Pre-Government Testing

3.7.2.1 Verification of Compliant Installation

Conduct inspections and tests to ensure that equipment is functioning properly. Tests must meet the requirements of paragraph entitled "Minimum System Tests" and "System Acceptance" as noted in NFPA 13. The Contractor and QFPE must be in attendance at the pre-Government testing to make necessary adjustments. After inspection and testing is complete, provide a signed Verification of Compliant Installation letter by the QFPE that the installation is complete, compliant with the specification and fully operable. The letter must include the names and titles of the witnesses to the pre-Government tests. Provide all completion documentation as required by NFPA 13 and the test reports noted below.

- a. NFPA 13 Aboveground Material and Test Certificate

b. NFPA 13 Underground Material and Test Certificate

3.7.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit a formal request for Government final test to the Contracting Officers Designated Representative (COR). Government final testing will not be scheduled until the DFPE has received copies of the request for Government final testing and Verification of Compliant Installation letter with all required reports. Government final testing will not be performed until after the connections to the building fire alarm system have been completed and tested to confirm communications are fully functional. Submit request for test at least 15 calendar days prior to the requested test date.

3.7.3 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.7.4 Government Final Tests

The tests must be performed in accordance with the approved test procedures in the presence of the DFPE. Furnish instruments and personnel required for the tests. The following must be provided at the job site for Government Final Testing:

- a. The manufacturer's technical representative.
- b. The contractor's Qualified Fire Protection Engineer (QFPE).
- c. Marked-up red line drawings of the system as actually installed.

Government Final Tests will be witnessed by the Designated Fire Protection Engineer and Qualified Fire Protection Engineer (QFPE). At this time, all required tests noted in the paragraph "Minimum System Tests" must be repeated at their discretion.

3.8 MINIMUM SYSTEM TESTS

The system, including the underground water mains, and the aboveground piping and system components, must be tested to ensure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure must be tested in accordance with NFPA 13 and NFPA 24.

3.8.1 Underground Piping

3.8.1.1 Flushing

Underground piping must be flushed at a minimum of 10 fps in accordance with NFPA 24.

3.8.1.2 Hydrostatic Test

New underground piping must be hydrostatically tested in accordance with

NFPA 24.

3.8.2 Aboveground Piping

3.8.2.1 Hydrostatic Test

Aboveground piping must be hydrostatically tested in accordance with NFPA 13. There must be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure must be read from a gauge located at the low elevation point of the system or portion being tested.

3.8.2.2 Backflow Prevention Assembly Forward Flow Test

Each backflow prevention assembly must be tested at system flow demand, including all applicable hose streams, as specified in NFPA 13. The Contractor must provide all equipment and instruments necessary to conduct a complete forward flow test, including 2.5-inch diameter hoses, playpipe nozzles or flow diffusers, calibrated pressure gauges, and pitot tube gauge. The Contractor must provide all necessary supports to safely secure hoses and nozzles during the test. At the system demand flow, the pressure readings and pressure drop (friction loss) across the assembly must be recorded. A metal placard must be provided on the backflow prevention assembly that lists the pressure readings both upstream and downstream of the assembly, total pressure drop, and the system test flow rate determined during the preliminary testing. The pressure drop must be compared to the manufacturer's data and the readings observed during the final inspections and tests.

3.8.3 Main Drain Flow Test

Following flushing of the underground piping, a main drain test must be made to verify the adequacy of the water supply. Static and residual pressures must be recorded on the certificate specified in paragraph SUBMITTALS.

3.9 SYSTEM ACCEPTANCE

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. Submit six sets of detailed as-built drawings. The drawings must show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings must be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings must be provided at the time of, or prior to the final acceptance test.

- a. 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, DXF and portable document formats of as-built drawings and schematics.
- b. Provide operating and maintenance (O&M) instructions.

3.10 ONSITE TRAINING

Conduct a training course for the responding fire department and operating and maintenance personnel as designated by the Contracting Officer. Training must be performed on two separate days (to accommodate different

shifts of Fire Department personnel) for a period of 4 hours of normal working time and must start after the system is functionally complete and after the final acceptance test. The on-site training must cover all of the items contained in the approved Operating and Maintenance Instructions.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 22 - PLUMBING

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE

11/15, CHG 4: 05/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
 - 1.2.1 Sustainable Design Submittals
- 1.3 STANDARD PRODUCTS
 - 1.3.1 Alternative Qualifications
 - 1.3.2 Service Support
 - 1.3.3 Manufacturer's Nameplate
 - 1.3.4 Modification of References
 - 1.3.4.1 Definitions
 - 1.3.4.2 Administrative Interpretations
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 PERFORMANCE REQUIREMENTS
 - 1.5.1 Welding
- 1.6 REGULATORY REQUIREMENTS
- 1.7 PROJECT/SITE CONDITIONS
- 1.8 INSTRUCTION TO GOVERNMENT PERSONNEL
- 1.9 ACCESSIBILITY OF EQUIPMENT
- 1.10 WARRANTY

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Pipe Joint Materials
 - 2.1.2 Miscellaneous Materials
 - 2.1.3 Pipe Insulation Material
- 2.2 PIPE HANGERS, INSERTS, AND SUPPORTS
- 2.3 VALVES
 - 2.3.1 Wall Faucets
 - 2.3.2 Wall Hydrants (Frostproof)
 - 2.3.3 Relief Valves
 - 2.3.4 Thermostatic Mixing Valves
- 2.4 FIXTURES
 - 2.4.1 Lavatories
 - 2.4.2 Automatic Controls
 - 2.4.3 Flush Valve Water Closets
 - 2.4.4 Flush Valve Urinals
 - 2.4.5 Wheelchair Flush Valve Type Urinals
 - 2.4.6 Wall Hung Lavatories
 - 2.4.7 Countertop Lavatories
 - 2.4.8 Break Room Sinks
 - 2.4.9 Wheelchair Drinking-Water Coolers
 - 2.4.10 Precast Terrazzo Mop Sinks
- 2.5 BACKFLOW PREVENTERS
- 2.6 DRAINS

- 2.6.1 Floor Drains
- 2.6.2 Floor Sinks
- 2.7 TRAPS
- 2.8 WATER HEATERS
 - 2.8.1 Automatic Electric Storage Type
 - 2.8.1.1 Electric Type
- 2.9 PUMPS
 - 2.9.1 Sump Pumps
 - 2.9.2 Circulating Pumps
- 2.10 DOMESTIC WATER SERVICE METER
- 2.11 ELECTRICAL WORK
- 2.12 MISCELLANEOUS PIPING ITEMS
 - 2.12.1 Escutcheon Plates
 - 2.12.2 Pipe Sleeves
 - 2.12.2.1 Sleeves in Masonry and Concrete
 - 2.12.2.2 Sleeves Not in Masonry and Concrete
 - 2.12.3 Pipe Hangers (Supports)
 - 2.12.4 Underground Pipe Hangers system
 - 2.12.4.1 Plumbing Pipe Support Below Structural Slabs
 - 2.12.5 Nameplates

PART 3 EXECUTION

- 3.1 GENERAL INSTALLATION REQUIREMENTS
 - 3.1.1 Water Pipe, Fittings, and Connections
 - 3.1.1.1 Utilities
 - 3.1.1.2 Cutting and Repairing
 - 3.1.1.3 Protection of Fixtures, Materials, and Equipment
 - 3.1.1.4 Mains, Branches, and Runouts
 - 3.1.1.5 Pipe Drains
 - 3.1.1.6 Expansion and Contraction of Piping
 - 3.1.1.7 Thrust Restraint
 - 3.1.1.8 Commercial-Type Water Hammer Arresters
 - 3.1.2 Joints
 - 3.1.2.1 Threaded
 - 3.1.2.2 Unions and Flanges
 - 3.1.2.3 Cast Iron Soil, Waste and Vent Pipe
 - 3.1.2.4 Copper Tube and Pipe
 - 3.1.2.5 Other Joint Methods
 - 3.1.3 Dissimilar Pipe Materials
 - 3.1.4 Corrosion Protection for Buried Pipe and Fittings
 - 3.1.5 Pipe Sleeves and Flashing
 - 3.1.5.1 Sleeve Requirements
 - 3.1.5.2 Flashing Requirements
 - 3.1.5.3 Waterproofing
 - 3.1.5.4 Optional Counterflashing
 - 3.1.5.5 Pipe Penetrations of Slab on Grade Floors
 - 3.1.5.6 Pipe Penetrations
 - 3.1.6 Fire Seal
 - 3.1.7 Supports
 - 3.1.7.1 General
 - 3.1.7.2 Pipe Supports and Structural Bracing Requirements
 - 3.1.7.3 Pipe Hangers, Inserts, and Supports
 - 3.1.7.4 Structural Attachments
 - 3.1.8 Welded Installation
 - 3.1.9 Pipe Cleanouts
 - 3.1.10 Water Meter
- 3.2 WATER HEATERS
 - 3.2.1 Relief Valves

- 3.2.2 Heat Traps
- 3.2.3 Connections to Water Heaters
- 3.2.4 Expansion Tank
- 3.3 FIXTURES AND FIXTURE TRIMMINGS
 - 3.3.1 Fixture Connections
 - 3.3.2 Flushometer Valves
 - 3.3.3 Height of Fixture Rims Above Floor
 - 3.3.4 Fixture Supports
 - 3.3.4.1 Support for Solid Masonry Construction
 - 3.3.4.2 Support for Concrete-Masonry Wall Construction
 - 3.3.4.3 Support for Steel Stud Frame Partitions
 - 3.3.4.4 Wall-Mounted Water Closet Gaskets
 - 3.3.5 Backflow Prevention Devices
 - 3.3.6 Access Panels
 - 3.3.7 Traps
- 3.4 VIBRATION-ABSORBING FEATURES
- 3.5 WATER METER REMOTE READOUT REGISTER
- 3.6 IDENTIFICATION SYSTEMS
 - 3.6.1 Identification Tags
 - 3.6.2 Pipe Color Code Marking
 - 3.6.3 Color Coding Scheme for Locating Hidden Utility Components
- 3.7 ESCUTCHEONS
- 3.8 PAINTING
 - 3.8.1 Painting of New Equipment
 - 3.8.1.1 Factory Painting Systems
- 3.9 TESTS, FLUSHING AND DISINFECTION
 - 3.9.1 Plumbing System
 - 3.9.1.1 Test of Backflow Prevention Assemblies
 - 3.9.2 Defective Work
 - 3.9.3 System Flushing
 - 3.9.3.1 During Flushing
 - 3.9.3.2 After Flushing
 - 3.9.4 Operational Test
 - 3.9.5 Disinfection
- 3.10 TESTING, ADJUSTIN AND BALANCING
- 3.11 POSTED INSTRUCTIONS
- 3.12 PERFORMANCE OF WATER HEATING EQUIPMENT
 - 3.12.1 Storage Water Heaters
 - 3.12.1.1 Electric Storage Water Heater
- 3.13 TABLES

-- End of Section Table of Contents --

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE
11/15, CHG 4: 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.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1010 (2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.3/CSA 4.3 (2019) Gas-Fired Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous

ANSI Z21.22/CSA 4.4 (2015; R 2020) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.1.2 (2012; R 2017) Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)

ASME A112.6.1M (1997; R 2017) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use

ASME A112.6.3 (2019) Standard for Floor and Trench Drains

ASME A112.19.2/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 B16.12	(2019) Cast Iron Threaded Drainage Fittings
ASME B16.15	(2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2011) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.29	(2017) Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings - DWV
ASME B16.34	(2021) Valves - Flanged, Threaded and Welding End
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

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2016) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1010	(2004) Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1011	(2004; Errata 2004) Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)
ASSE 1012	(2009) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	(2011) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)
ASSE 1018	(2001; R 2021) Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002)
ASSE 1019	(2011; R 2016) Performance Requirements

for Wall Hydrant with Backflow Protection
and Freeze Resistance

ASSE 1020 (2020) Performance Requirements for
Pressure Vacuum Breaker Assemblies

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300 (2018) Hypochlorites

AWWA B301 (2018) Liquid Chlorine

AWWA C203 (2020) Coal-Tar Protective Coatings and
Linings for Steel Water Pipelines - Enamel
and Tape - Hot-Applied

AWWA C606 (2015) Grooved and Shouldered Joints

AWWA C651 (2014) Standard for Disinfecting Water
Mains

AWWA C652 (2019) Disinfection of Water-Storage
Facilities

AWWA C700 (2020) Cold-Water Meters - Displacement
Type, Metal Alloy Main Case

AWWA C701 (2019) Cold-Water Meters - Turbine Type
for Customer Service

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M (2019) Specification for Filler Metals for
Brazing and Braze Welding

ASME INTERNATIONAL (ASME)

ASME A17.1/CSA B44 (2021) Safety Code for Elevators and
Escalators

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 A193/A193M (2020) Standard Specification for
Alloy-Steel and Stainless Steel Bolting
Materials for High-Temperature Service and
Other Special Purpose Applications

ASTM A515/A515M (2017) Standard Specification for Pressure
Vessel Plates, Carbon Steel, for
Intermediate- and Higher-Temperature
Service

ASTM A516/A516M (2017) Standard Specification for Pressure

	Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A888	(2021) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B306	(2020) Standard Specification for Copper Drainage Tube (DWV)
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B584	(2014) 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 C564	(2020a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D2822/D2822M	(2005; R 2011; E 2011) Standard Specification for Asphalt Roof Cement, Asbestos-Containing
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D3212	(2007; R 2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D3311	(2017) Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns

ASTM E1 (2014) Standard Specification for ASTM
Liquid-in-Glass Thermometers

ASTM F477 (2014) Standard Specification for
Elastomeric Seals (Gaskets) for Joining
Plastic Pipe

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 COMM (2017) Standard And Commentary Accessible
and Usable Buildings and Facilities

ICC IPC (2021) International Plumbing Code

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

NACE INTERNATIONAL (NACE)

NACE SP0169 (2013) Control of External Corrosion on
Underground or Submerged Metallic Piping
Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2020) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NEMA MG 1 (2018) Motors and Generators

NEMA MG 11 (1977; R 2012) Energy Management Guide for
Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2021) Standard for the Installation of
Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF/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. GREEN BUILDING COUNCIL (USGBC)

LEED v4.1 BD+C LEED v4.1 Building Design and Construction

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 174	(2004; Reprint Feb 2021) UL Standard for Safety Household Electric Storage Tank Water Heaters
UL 430	(2015; Reprint Feb 2018) UL Standard for Safety Waste Disposers

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

Plumbing System; G

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings must indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details must include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, must be drawn to scale.

SD-03 Product Data

Backflow Prevention Assemblies; G

Fixtures; S

List of installed fixtures with manufacturer, model, and flow rate.

Flush Valve Water Closets; G

WaterSense Label for Flush Valve Water Closet; S

Flush Valve Urinals; G

WaterSense Label for Urinal; S

Wall Hung Lavatories; G

Countertop Lavatories; G

Breakroom Sinks; G

Wheelchair Drinking-Water Coolers; G

Energy Star Label for Wheelchair Electric Water Cooler; S

Water Heaters; G

Electric Storage Water Heater; S

Pumps; G

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Vibration-Absorbing Features; G

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System; G

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; G

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 must indicate the final position of controls.

Test of Backflow Prevention Assemblies; G.

Certification of proper operation must 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 must have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor must provide written documentation of the tests performed and signed by the individual performing the tests. Prior to testing, submit to the Contracting Officer certification issued by the State or Local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory authority.

SD-07 Certificates

Materials and Equipment; G

Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation must conform to the code.

Bolts; G

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements.

SD-10 Operation and Maintenance Data

Plumbing System; G

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.2.1 Sustainable Design Submittals

Low-Emitting Materials - Interior adhesives and sealants applied on site:

- a. Meet the VOC emissions evaluation and meet the VOC content evaluation. The adhesives and sealants product category include all interior adhesives and sealants applied on site. Refer to 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING and the LEED v4.1 BD+C for full VOC content and emissions requirements.
- b. Provide LEED Submittal Cover Sheet in accordance with 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.
- c. Provide Environmental Product Declarations (EPD) for plumbing fixtures in accordance with 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING.

1.3 STANDARD PRODUCTS

Specified materials and equipment must be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment must essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening. Standard products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 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 must be supported by service organizations. Submit a

certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations must be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 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.

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, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions must be considered mandatory, the word "should" must be interpreted as "must." Reference to the "code official" must be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" must be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" must be interpreted to mean the "lessor." References to the "permit holder" must be interpreted to mean the "Contractor."

1.3.4.2 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, must be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer must be notified 24 hours in advance of tests, and the tests must be performed at the work site if practicable. Welders or welding operators must apply their assigned symbols near each weld they

make as a permanent record. Structural members must be welded in accordance with Section 05 12 00 STRUCTURAL STEEL.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work must be in accordance with ICC IPC.

1.7 PROJECT/SITE CONDITIONS

The Contractor must 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 must be thoroughly familiar with all parts of the installation and must be trained in operating theory as well as practical operation and maintenance work.

Instruction must be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished must be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 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.

1.10 WARRANTY

Provide equipment with manufacturer's standard 2 year parts and labor warranty.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services must be in accordance with TABLES I and II.

Pipe schedules must be selected based on service requirements. Pipe fittings must be compatible with the applicable pipe materials. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers must 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, 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 must not be installed underground, under concrete floor slabs.

2.1.1 Pipe Joint Materials

Hubless cast-iron soil pipe must not be used underground. Solder containing lead must not be used with copper pipe. Cast iron soil pipe and fittings must be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials must conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Brazing Material: Brazing material must conform to AWS A5.8/A5.8M, BCuP-5.
- d. Brazing Flux: Flux must be in paste or liquid form appropriate for use with brazing material. Flux must 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 must conform to ASTM B32.
- f. Solder Flux: Flux must be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.
- g. Flexible Elastomeric Seals: ASTM D3139, ASTM D3212 or ASTM F477.
- h. Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns must be in accordance with ASME B16.5 class 150 and must have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material must conform to ASTM A105/A105M. Blind flange material must conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts must be high strength or intermediate strength with material conforming to ASTM A193/A193M.
- i. Copper tubing must conform to ASTM B88, Type K, L or M.

2.1.2 Miscellaneous Materials

Miscellaneous materials must conform to the following:

- a. Water Hammer Arrestor: PDI WH 201. Water hammer arrester must be piston type.
- b. Copper, Sheet and Strip for Building Construction: ASTM B370.
- c. Asphalt Roof Cement: ASTM D2822/D2822M.
- d. Hose Clamps: SAE J1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines:

AWWA C203.

- h. Hypochlorites: AWWA B300.
- i. Liquid Chlorine: AWWA B301.
- j. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.
- k. Thermometers: ASTM E1. Mercury must not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation must 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 must conform to MSS SP-58.

2.3 VALVES

Valves must be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller must be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger must have flanged iron bodies and bronze trim. Pressure ratings must 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 must conform to the following standards:

Description	Standard
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves and Threaded Ends	ASME B16.34

Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
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

2.3.1 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer must be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle must be securely attached to stem.

2.3.2 Wall Hydrants (Frostproof)

ASSE 1019 with vacuum-breaker backflow preventer must have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod must be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat must be provided. Valve rod and seat washer must be removable through the face of the hydrant. The hydrant must have 3/4 inch exposed hose thread on spout and 3/4 inch male pipe thread on inlet.

2.3.3 Relief Valves

Water heaters and hot water storage tanks must have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve must 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 must have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves must 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 must 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 must have 1 inch minimum inlets, and 1 inch outlets. The discharge pipe from the relief valve must be the size of the valve outlet.

2.3.4 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and

pressure-balanced must be line size and must be constructed with rough or finish bodies either with or without plating. Each valve must 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 must be of an approved type. The body must be of heavy cast bronze, and interior parts must be brass, bronze, corrosion-resisting steel or copper. The valve must be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves must maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Water closet replacements in major renovations may have a flush valve of up to 1.28 GPF to accommodate existing plumbing capacity. Fixtures for use by the physically handicapped must be in accordance with ICC A117.1 COMM. Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body must be provided. Porcelain enameled ware must 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 must 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, must be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts must be provided for supports, and polished chromium-plated pipe, valves, and fittings must be provided where exposed to view. Fixtures with the supply discharge below the rim must be equipped with backflow preventers. Internal parts of flush valves and flushometer valves, pop-up stoppers of lavatory waste drains must be copper alloy with all visible surfaces chrome plated.

2.4.1 Lavatories

Vitreous china lavatories must 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 faucet with a maximum flow rate of 0.35 gpm at a flowing pressure of 60 psi. Water volume must be limited to 0.1 gal per metering cycle.

2.4.2 Automatic Controls

Flushing and faucet systems must consist of solenoid-activated valves with light beam sensors. Flush valve for water closet must include an override pushbutton. Flushing devices must 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 must 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 must be 1.28 gallon per flush, and a MaP (Maximum Performance) minimum rating of 1,000.. 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 must be chromium-plated or polished stainless steel. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve must not interfere with the hand rail in ADA stalls. Provide hard-wired solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.4 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 must not exceed .125 gallon per flush. 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 must be chromium-plated or polished stainless steel. Flush valves must be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Provide hard-wired 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, 14 inches long from wall to front of flare, 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 must not exceed 0.125 gallon per flush. 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 hard-wired 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 aerator with faucet. Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset lavatory faucets. Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the hard-wired 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, under counter mount, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Provide aerator with faucet. 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 washerless centerset lavatory faucets. Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the hard-wired solenoid.

2.4.8 Break Room 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, single compartment, 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. Provide aerator with faucet. Water flow rate must not exceed 1.5 gpm when measured at a flowing water pressure of 60 psi. Provide stainless steel drain outlets and stainless steel cup strainers. Provide separate 1.5 inch P-trap and drain piping to vertical vent piping from each compartment. Provide top mounted washerless sink faucets with hose spray. Provide UL 430 waste disposer in right compartment.

2.4.9 Wheelchair Drinking-Water Coolers

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 must also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet. Provide electric water cooler that is Energy Star labeled. Provide data identifying Energy Star label for wheelchair electric water cooler.

2.4.10 Precast Terrazzo Mop Sinks

Terrazzo must 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.

2.5 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 must be meet the above requirements.

Backflow preventers with intermediate atmospheric vent must conform to ASSE 1012. Reduced pressure principle backflow preventers must conform to ASSE 1013. Hose connection vacuum breakers must conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers must conform to ASSE 1001. Pressure vacuum breaker assembly must conform to ASSE 1020. Air gaps in plumbing systems must conform to ASME A112.1.2.

Reduced Pressure Zone Assemblies must be installed at each potential health hazard location to prevent backflow due to backsiphonage and/or backpressure. The assembly must consist of a pressure differential relief valve located in a zone between two positive seating check valves. Seats and seat discs must be replaceable in both check valves and the relief valve without the use of special tools. Service of all internal check valve components must be through top mounted access covers threaded to the main valve body. The check valve poppet assembly must be guided via the use of a corrosion resistant plastic guide. The check valve and relief valve seats must be push-in type. The relief valve cover must be secured with stainless steel bolts and must utilize a quarter-turn locking joint to capture the spring load of the relief valve. The relief valve must have an internal sensing line to sense the inlet water supply. All rubber elastomers must be of chloramine resistant material. The assembly must also include two resilient seated isolation valves, four top-mounted resilient seated test cocks and an air gap drain fitting.

2.6 DRAINS

2.6.1 Floor Drains

Floor drains must 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 must be cast iron except where metallic waterproofing membrane is installed. Drains must be of double drainage pattern for embedding in the floor construction. The seepage pan must have weep holes or channels for drainage to the drainpipe. The strainer must 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 must be provided when required. Drains must 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 drains must conform to ASME A112.6.3. Provide drain with trap primer connection, trap primer, and connection piping. Primer must meet ASSE 1018.

2.6.2 Floor Sinks

Floor sinks must be square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink must have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size must be as indicated or of the same size as the connecting pipe.

2.7 TRAPS

Unless otherwise specified, traps must copper-alloy adjustable tube type

with slip joint inlet and swivel. Traps must be without a cleanout. Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes must 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 must have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints must be below the discharge level and must be of metal-to-metal or metal-to-plastic type as required for the application. Nuts must have flats for wrench grip. Outlets must have internal pipe thread, except that when required for the application, the outlets must have sockets for solder-joint connections. The depth of the water seal must be not less than 2 inches. The interior diameter must be not more than 1/8 inch over or under the nominal size, and interior surfaces must 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 must be provided for lavatories. The assembly must be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 WATER HEATERS

Water heater types and capacities must be as indicated. Each water heater must have replaceable anodes. Each primary water heater must have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater must have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems must be tied into building off-hour controls. The thermal efficiencies and standby heat losses must 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 must be installed on the cold water supply to each water heater. Expansion tanks must be specifically designed for use on potable water systems and must be rated for 200 degrees F water temperature and 150 psi working pressure. The expansion tank size and acceptance volume must be as indicated. Provide water heater that is Energy Star eligible with Energy Star label. Provide data identifying Energy Star Label for Water Heater.

2.8.1 Automatic Electric Storage Type

Heaters must be complete with control system, temperature gauge, and pressure gauge, and must have ASME rated combination pressure and temperature relief valve.

2.8.1.1 Electric Type

Electric type water heaters must conform to UL 174 with dual heating elements. Each element must be 4.5 KW. The elements must be wired so that only one element can operate at a time.

2.9 PUMPS

2.9.1 Sump Pumps

Sump pump located in elevator pit must remove water in accordance with ASME A17.1/CSA B44 and provide pump shutdown in the event that oily water is detected. Pump and motor include an alarm that will be activated in the event of high water or high oil condition. The discharged line from the pump must be provided with a union or flange, a nonclog swing check valve in an accessible location above the sump pit.

2.9.2 Circulating Pumps

Domestic hot water circulating pumps must be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor must be supported by the piping on which it is installed. The shaft must be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

Motor must be totally enclosed, fan-cooled and must have sufficient horsepower for the service required. Each pump motor must 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 must be premium efficiency type in accordance with NEMA MG 1. Pump motors smaller than 1 hp Fractional horsepower pump motors must have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards must shield exposed moving parts.

2.10 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller must be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger must be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, indicating as provided by the local utility. Meter must be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

Meters must be connected to the base wide energy and utility monitoring and control system (if this system exists) using the installation's advanced metering protocols.

Meter configuration and outputs must be coordinated with controls system outputs required and for base wide metering ARMS system requirements. Meter configuration and outputs must be coordinated for base wide cybersecurity requirements

AMRS compatible water metering solutions consist of a componential system to achieve the goal of delivering water consumption data into the AMRS. To accurately scale output pulses the contractor must obtain building water usage from base personnel, taking into account peak demand when sizing the components that are necessary as well as determining peak pulse rate as to not saturate the receiving device and risk losing captured pulse data. The various components that may be necessary include but are not limited to the following: Water Meter, Pulse Kit, High Speed Dividing Pulse Relay, Surge Suppression Device, Accumulator, and Electric Meter with digital input availability:

- a. Pulse kit must be able to produce a two-wire (Form A) pulse output via RS485.
- b. Water meter or attached pulse kit must include a visual register or dial.
- c. Pulse output must be delivered to a high speed dividing pulse relay that has the capability of producing a wetting voltage if necessary.
- d. High speed dividing pulse relay must provide isolated pulse outputs (Form A) that must be delivered to an AMRS compatible electric meter.
- e. Water meters that can communicate to AMRS via the Modbus/TCP protocol may be acceptable if they can pass technical and cybersecurity evaluations directed by the AMRS PMO. At this time there are no tested or approved Modbus /TCP water meters.
- f. All meter labels must be white on black phenolic.

The following list of meters were evaluated, meet the AMRS meter specification and must function within the AMRS platform. All networked devices, their integrated firmware and software will be approved by the PMO for use in the AMRS. PMO approval is contingent upon the device, in its fielded configuration, passing USAF cyber and AMRS compatibility testing.

- a. Schneider Electric PM5560
- b. Schneider Electric PM8000
- c. Schneider Electric ION 8650
- d. Siemens 9410
- e. Siemens 9810
- f. Schneider Electric ION 8600 (currently connected to AMRS only, no new installs)
- g. Electro Industries Nexus 1272 (currently connected to AMRS only, no new installs)
- h. Electro Industries Nexus 1262 (currently connected to AMRS only, no new installs)
- i. Schneider Electric PM800 (currently connected to AMRS only, no new installs)

The following device is compatible with the AMRS platform, is consistent with the need of the existing site conditions, and has been tested and passed cybersecurity requirements:

- a. Schneider Electric EGX150 Ethernet Gateway

2.11 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 must be rated for continuous duty with the enclosure specified. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. 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 the enclosure.

Controllers and contactors must 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, must be provided. For packaged equipment, the manufacturer must provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment must be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.12 MISCELLANEOUS PIPING ITEMS

2.12.1 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.

2.12.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where supply drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.12.2.1 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.

2.12.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.12.3 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.

2.12.4 Underground Pipe Hangers system

2.12.4.1 Plumbing Pipe Support Below Structural Slabs

- a. All plumbing pipes must be supported by an approved suspension system.

b. System Structure:

1. Provides a dimensionally stable underground void space that is independent from the overhead structural slab. The subterranean system must support the weight of suspended lateral pipes and typical backfill material throughout the construction process.
2. The system must be designed to temporarily position and suspend the lateral pipes at the specified height and slope until pipes are permanently anchored to the overhead structural slab by the securing hanger (clevis) system. The open, underground system will then remain independent from the securing hangers.
3. The open space of the system beneath the structural slab is designed to receive the infill of vertical expansion from the underlying soils. If vertical pressure is applied to the edges of the system in contact with the soil, the uplifting soil pressure will apply exclusively to the system and not the pipes. Therefore, the system must be designed to move separately and independently of the lateral pipes.

c. System Components:

1. The system must have waterproof components related to its intended performance.
2. The system must maintain its structural integrity in all humid environments.
3. The system must have industry-proven performance in inclement weather conditions.
4. The system must be able to perform when submerged in water.
5. All system components, excluding clevises, threaded rods, and nuts, must be furnished by the designed system manufacturer.
6. It is recommended that all independent components not included in the designed system should comply with the project specifications in order to get the intended results of the designed system.
7. Each vertical threaded rod must have a component secured toward the top end and be permanently affixed into the concrete slab in order to maintain the specified elevation.
8. System must be installed per the manufacturer's requirements and recommendations.
9. Acceptable Products: Proven systems that comply with these requirements.

2.12.5 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 must 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 must conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts must 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 must be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping must be extended 5 feet outside the building, unless otherwise indicated. A gate valve and drain must be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping must be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes must be laid in separate trenches, except when otherwise shown. Exterior underground utilities must 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 must be marked with a stake or other acceptable means. Valves must 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 must be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system must 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, must 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 and flushing devices must be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work must be carefully laid out in advance, and unnecessary cutting of construction must be avoided. Damage to building, piping, wiring, or equipment as a result of cutting must be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings must be closed with caps or plugs during installation. Fixtures and equipment must be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment must be thoroughly cleaned, adjusted, and operated. Safety guards must be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping must be installed as indicated. Pipe must be accurately cut and worked into place without springing or forcing. Structural portions of the building must not be weakened. Aboveground piping must 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 must 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 must 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 must not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes must 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 must 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 must 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 must consist of 3/4 inch hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps must be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance must be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser must have expansion loops or other provisions such as offsets and changes in direction where indicated and required. Risers must be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers must 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 must be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility must be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility must 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 must be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking must 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 must 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 must be poured against undisturbed earth. The side of the thrust block not subject to thrust must be poured against forms. The area of bearing will be as shown. Blocking must 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, must 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 must be provided on hot- and cold-water supplies and must be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, must be accessible by means of access doors or removable panels. Commercial-type water hammer arresters must conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

3.1.2 Joints

Installation of pipe and fittings must 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 must be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints must have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads must be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or must have a polytetrafluoroethylene tape applied.

3.1.2.2 Unions and Flanges

Unions, flanges and mechanical couplings must not be concealed in walls, ceilings, or partitions. Unions must be used on pipe sizes 2-1/2 inches and smaller; flanges must 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 must be installed per the manufacturer's recommendations.

3.1.2.4 Copper Tube and Pipe

Soldered. Soldered joints must be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints must conform to ASME B31.5 and CDA A4015. Soldered joints must not be used in compressed air piping between the air compressor and the receiver.

3.1.2.5 Other Joint Methods

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe must be made with dielectric unions or flange waterways. Dielectric waterways must have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways must have metal

connections on both ends suited to match connecting piping. Dielectric waterways must be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges must meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe must be made with transition fitting for the specific purpose.

3.1.4 Corrosion Protection for Buried Pipe and Fittings

Ductile iron, cast iron, and steel pipe, fittings, and joints must have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe must have a cathodic protection system and joint bonding. The cathodic protection system, protective coating system, and joint bonding for cathodically protected pipe must be in accordance with Section 26 42 13 GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM. Coatings must be selected, applied, and inspected in accordance with NACE SP0169 and as otherwise specified. The pipe must be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings must be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape must conform to AWWA C203 and must be applied with a 50 percent overlap. Primer utilized with tape type coating systems must be as recommended by the tape manufacturer.

3.1.5 Pipe Sleeves and Flashing

Pipe sleeves must be furnished and set in their proper and permanent location.

3.1.5.1 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 must 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 must 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 must cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly must be sized as recommended by the manufacturer to fit the pipe and sleeve involved.
- c. Sleeves must not be installed in structural members, except where indicated or approved. Rectangular and square openings must be as detailed. Each sleeve must extend through its respective floor, or roof, and must 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 must extend a minimum of 4 inches above the finished floor.

- d. Unless otherwise indicated, sleeves must 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 must 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, must 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 must not be sealed for interior walls which are not designated as fire rated.
- f. Sleeves through below-grade walls in contact with earth must be recessed 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve must be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified above. Sealant selected for the earth side of the wall must be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls must conform to the requirements in Section 07 84 00 FIRESTOPPING.

3.1.5.2 Flashing Requirements

Pipes passing through roof must be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing must be suitably formed, and the skirt or flange must extend not less than 8 inches from the pipe and must be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing must extend up the pipe a minimum of 10 inches. For cleanouts, the flashing must be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs must 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 must be sealed as indicated. Flashing for dry vents must 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 must be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane must be sleeved as described above. A waterproofing clamping flange must be installed.

3.1.5.3 Waterproofing

Waterproofing at floor-mounted water closets must be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet must be perforated and turned down approximately 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard must be embedded in sealant to a depth of approximately 1-1/2 inches; then the sealant must be finished off flush to floor level.

between the flashing guard and drainpipe. The flashing guard of sheet copper must extend not less than 8 inches from the drainpipe and must be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe must be sealed with sealant and the flashing guard must be upturned approximately 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange must be sealed.

3.1.5.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

3.1.5.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs FLASHING REQUIREMENTS and WATERPROOFING, a groove 1/4 to 1/2 inch wide by 1/4 to 3/8 inch deep must be formed around the pipe, fitting or drain. The groove must be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.5.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations must be sealed to prevent infiltration of air, insects, and vermin.

3.1.6 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal must be provided as specified in Section 07 84 00 FIRESTOPPING.

3.1.7 Supports

3.1.7.1 General

Hangers used to support piping 2 inches and larger must be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors must 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 must 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 must be used 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. Threaded sections of rods must not be formed or bent.

3.1.7.2 Pipe Supports and Structural Bracing Requirements

Piping and attached valves must be supported and braced to resist loads as specified in Section 23 05 48.19 BRACING FOR HVAC. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, must be provided. Material used for supports must be as specified in Section 05 12 00 STRUCTURAL STEEL.

3.1.7.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports must conform to MSS SP-58 except as modified herein.

- a. Types 5, 12, and 26 must not be used.
- b. Type 3 must not be used on insulated pipe.
- c. Type 18 inserts must 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 must be torqued per MSS SP-58 and must 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 must 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 must be used on insulated pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher. Type 39 saddles must be welded to the pipe.
- h. Type 40 shields must:
 - (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 must have a density of 8 pcf or greater.
- i. Horizontal pipe supports must be spaced as specified in MSS SP-58 and a support must be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports must be spaced not over 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe must be 120 degrees F for PVC and 180 degrees F for CPVC. Horizontal pipe runs must include allowances for expansion and contraction.
- j. Vertical pipe must 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 must include allowances for expansion and contraction.

- k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides must be provided to allow longitudinal pipe movement. Slide materials must be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints must be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
 - (1) On pipe 4 inches and larger when the temperature of the medium is 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
 - (2) On pipe less than 4 inches a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
 - (3) On pipe 4 inches and larger carrying medium less than 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- l. Pipe hangers on horizontal insulated pipe must be the size of the outside diameter of the insulation. The insulation must 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 must include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe must be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

3.1.7.4 Structural Attachments

Plumbing equipment, piping and associated controls conduit must not be supported from overhead concrete filled metal decks or metal trays. Provide supports from structural framing to the greatest extent possible.

Concrete anchors and attachments included in this section are intended for utilization where attachment to structural framing is not possible. Provide scale layout and expected anchor sizing and carrying capacity calculations for wherever this occurs for approval.

Where necessary, 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. Supports must not be attached to metal decking. Supports must 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 must be constructed of ferrous materials only.

3.1.8 Welded Installation

Plumbing pipe weldments must be as indicated. Changes in direction of piping must be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings must be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld must conform to ASME B31.1. Weld defects must be removed and repairs made to the weld, or the weld joints must be entirely removed and rewelded. After filler metal has been removed from its

original package, it must be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating must not be used.

3.1.1.9 Pipe Cleanouts

Pipe cleanouts must 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 must 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 must be caulked into the hub of the fitting and must be flush with the floor. Cleanouts in connection with other pipe, where indicated, must be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs. Plugs must be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug must 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 must be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers must 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 must have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic must 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 must not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads must be cast iron.

3.1.1.10 Water Meter

Contractor must assume all existing equipment is working properly. If during the post award survey portion of the SOW an existing piece of equipment is found to be malfunctioning, then the contractor must bring it to the government's attention to determine how to proceed. An RFI must be submitted. This may require a contract change to delete this meter from the scope or to add a new meter.

All due diligence to survey the existing site conditions is the responsibility of the contractor.

New and relocated electric meters must be installed adjacent to the main distribution panel in a separate enclosure unless otherwise noted.

All new and relocated meter assemblies be located approximately 5 feet above the ground (4 feet minimum -- 6 feet maximum).

All new meter installations, including relocated existing meters, must include the installation of new properly sized split or solid core current transformers (CTs). Accurate sizing of new CTs is the responsibility of the contractor.

If CT installation method includes disturbing the bonds of existing cables or wiring within the gear, before and after IR scans must be performed

before removing and after torquing the connections to ensure the integrity of the conductor bonds.

All new meter installations, including relocated existing meters, three phase voltage must be supplied from a breaker, disconnect or fused source which must be finger safe, labeled at the electrical meter and electrical panel.

All meter safety disconnect switches must be marked as follows "Meter Disconnect NOT Service Equipment" per the NEC. In addition, instructions to safely engage the safety disconnect switches and finger safe shorting blocks for CT conductors must be included inside each meter assembly.

Meter assemblies must be provided with finger safe voltage and current safety disconnect devices or equivalent so that the meter assembly can be worked on safely over the life of the meter installation and not require utility outages for servicing. Additionally, meters must have control power regardless of breaker position when installed in a split buss switchgear.

In the event communications equipment and/or a metering device has to be located in an exterior location, the meter enclosure must be a lockable NEMA 4 enclosure. All new install interior meters are required to be enclosed in a lockable NEMA 3 enclosure unless otherwise noted.

All new meter installations, including relocated existing meters, must be connected via CAT6 cable from the meter, to a wall outlet in the mechanical room, to a patch panel in the communications room, and then to the Air Force switch in the communications room.

Cables labels must be permanent, wrap-around and self-laminating with text generated by a mechanical device. Labels must be applied at both ends of the cable, visible during normal maintenance of the infrastructure, resistant to environmental conditions (such as moisture, heat or ultraviolet light), and have a design life equal to or greater than that of the labeled component.

Preferred technical approach to network communication cabling in excess of 328 feet is: Fiber optic cable and fiber media converters with dedicated power outlets. Fiber media converter must be installed in the communications room within 6 feet of the network switch and within 6 feet of the electric meter enclosure.

All meter labels must be white on black phenolic.

All data cable test results (including fiber) must be completed only after the cable has been terminated in its permanent location, temporary cable test results will not be accepted.

Surge protection is required on all communication cabling extending from the exterior to the interior of a facility. This includes gas meter communication cables from the exterior to the interior of the building. Surge suppression devices must be installed w/in 3 feet of the building entrance inside the facility unless otherwise noted. Devices must be easily accessible and labeled to aide in location during future troubleshooting efforts. Surge protection devices must be Power over Ethernet (PoE) compatible and housed within an enclosure that allows space for a proper cable bend radius.

Meter assemblies and communication receptacles accessible to the public must be installed in a locked enclosure.

Electric meters with gas or water meters connected must have two internal registers configured - one for a raw pulse count and one for a weighted pulse count based on the scaling of the connected gas or water meter.

3.2 WATER HEATERS

3.2.1 Relief Valves

No valves must be installed between a relief valve and its water heater or storage tank. The P&T relief valve must be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve must be installed directly in a tapping in the tank or heater; otherwise, the P&T valve must be installed in the hot-water outlet piping. A vacuum relief valve must 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 water heater.

3.2.2 Heat Traps

Piping to and from each water heater and hot water storage tank must be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

3.2.3 Connections to Water Heaters

Connections of metallic pipe to water heaters must be made with dielectric unions or flanges.

3.2.4 Expansion Tank

A pre-charged expansion tank must be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor must 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 must 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 must be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool must be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment must be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons must be as specified. Drain lines and hot water lines of fixtures for handicapped personnel must be insulated and do not require polished chrome finish. Plumbing fixtures and accessories must 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 must be provided. Connections between earthenware fixtures and flanges on soil pipe must 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 must 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 must 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 must be installed 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves must 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 must be installed on the wide side of the enclosure.

3.3.3 Height of Fixture Rims Above Floor

Lavatories must be mounted with rim 31 inches above finished floor. Wall-hung drinking fountains and water coolers must be installed with rim 42 inches above floor. Wall-hung service sinks must be mounted with rim 28 inches above the floor. Installation of fixtures for use by the physically handicapped must be in accordance with ICC A117.1 COMM.

3.3.4 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, must be of the chair-carrier type. The carrier must provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability must be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, must 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 must be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate must be imbedded in the masonry wall.

3.3.4.2 Support for Concrete-Masonry Wall Construction

Chair carrier must be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate must 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 must be used. The anchor feet and tubular uprights must be of the heavy duty design; and feet (bases) must be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, must 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 must be provided. The type of gasket furnished must be as recommended by the chair-carrier manufacturer.

3.3.5 Backflow Prevention Devices

HVAC makeup water connections, Plumbing fixtures, equipment, and pipe connections must not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers must 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 must 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 must be located so that no part of the device will be submerged. Backflow preventers must 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 must not be provided around backflow preventers. Access must be provided for maintenance and testing. Each device must be a standard commercial unit. Installers of backflow preventers must be licensed in backflow prevention and cross connection control.

3.3.6 Access Panels

Access panels must be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels must be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels must be as specified in Section 08 31 00 ACCESS DOORS AND PANELS.

3.3.7 Traps

Each trap must be placed as near the fixture as possible, and no fixture must be double-trapped. Traps installed on cast-iron soil pipe must be cast iron. Traps installed on steel pipe or copper tubing must be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D3311. Traps for acid-resisting waste must be of the same material as the pipe.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment and pumps, must be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation must include an adequate number of standard isolation units. Each unit must consist of machine and floor or foundation fastening, together with intermediate isolation material, and must be a standard product with printed load rating. Piping connected to mechanical equipment must be provided with flexible connectors.

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register must be mounted at the location indicated or as directed by the Contracting Officer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number must be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags must be 1-3/8 inch minimum diameter, and marking must be stamped or engraved. Indentations must be black, for reading clarity. Tags must be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping must be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme must be provided in buildings having suspended grid ceilings. The color coding scheme must 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 must include valves, dampers, switches, linkages and thermostats. The color coding scheme must consist of a color code board and colored metal disks. Each colored metal disk must be approximately 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners must be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners must be manually removable without tools and must not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks must follow completion of the finished surface on which the disks are to be fastened. The color code board must have the approximate dimensions of 3 foot width, 30 inches height, and 1/2 inch thickness. The board must be made of wood fiberboard and framed under glass or 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols must be approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. The color code board must be mounted and located in the mechanical or equipment room. The color code system must be per facility standards.

3.7 ESCUTCHEONS

Escutcheons must 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 must be fastened securely to pipe or pipe covering and must be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons must be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.8.1 Painting of New Equipment

New equipment painting must be factory applied or shop applied, and must be as specified herein, and provided under each individual section.

3.8.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system must be designed for the temperature service.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests must be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test must 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 must include a smoke test.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly must be tested using gauges specifically designed for the testing of backflow prevention assemblies.

Backflow prevention assembly test gauges must 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 must 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. Prior to testing, a copy of the current test gauge calibration must be provided to the Contracting Officer. Report form for each assembly must 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 must be repaired and retested.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material must be replaced or repaired as necessary and inspection and tests must be repeated. Repairs to piping must be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system must be flushed with hot potable water. Sufficient water must 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 must specify the number of fixtures to be operated during flushing. Contractor must 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 must be responsible for any flood damage resulting from flushing of the system. Flushing must 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, must be flushed a minimum of 0.25 gallons per 24 hour period, ten times over a 14 day period.

3.9.3.2 After Flushing

System must be drained at low points. Strainer screens must be removed, cleaned, and replaced. After flushing and cleaning, systems must 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 must be repaired by the Contractor. When the system flushing is complete, the hot-water system must be adjusted for uniform circulation. Flushing devices and automatic control systems must 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 must not exceed limits established by 40 CFR 141.80 (c)(1). The water supply to the building must be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor must subject the plumbing system to operating tests to demonstrate satisfactory installation, connections, adjustments, and functional and operational efficiency. Such operating tests must cover a period of not less than 8 hours for each system and must include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

3.9.5 Disinfection

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system must be disinfected. Before introducing disinfecting chlorination material, entire system must be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure must be in accordance with AWWA C651 and AWWA C652 as modified and supplemented by this specification. The chlorinating material must be hypochlorites or liquid chlorine. The chlorinating material must 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 must 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 must 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 must 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 must be EPA approved for drinking water systems and must comply with applicable local and state requirements.

Disinfection must 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.

3.10 TESTING, ADJUSTIN AND BALANCING

The requirements for testing, adjusting, and balancing (TAB) are specified in 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC. Begin TAB only when the water supply and distribution, including controls, has been completed, with the exception of operational tests and disinfection." TAB must include domestic hot water circulating system along with DHWS.

3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, must 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 must be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions must be posted before acceptance testing of the systems.

3.12 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)

3.12.1 Storage Water Heaters

3.12.1.1 Electric Storage Water Heater

- a. Storage capacity of 60 gallons must have a minimum energy factor (EF) of 0.93 or higher per FEMP requirements.
- b. Storage capacity of 60 gallons or more must have a minimum energy factor (EF) of 0.91 or higher per FEMP requirements.

3.13 TABLES

TABLE I						
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS						
<u>Item #</u>	<u>Pipe and Fitting Materials</u>	<u>SERVICE A</u>	<u>SERVICE B</u>	<u>SERVICE C</u>	<u>SERVICE D</u>	<u>SERVICE E</u>
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A74 with compression gaskets. Pipe and fittings must be marked with the CISPI trademark.	X	X	X	X	X
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A888. Pipe and fittings must be marked with the CISPI trademark.		X	X	X	X
3	Cast iron drainage fittings, threaded, ASME B16.12	X		X	X	
4	Copper drainage tube, (DWV), ASTM B306	X*	X	X*	X	X

TABLE I						
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E
5	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X
6	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	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 - 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
1	Seamless copper pipe, ASTM B42	X	X		X
2	Seamless copper water tube, ASTM B88, ASTM B88M	X**	X**	X**	X***
3	Cast bronze threaded fittings, ASME B16.15 for use with Item 1	X	X		X
4	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Item 1	X	X	X	X
5	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Item 2	X	X	X	X

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 180 degrees F Maximum Aboveground C -Cold Water Service Belowground Indicated types are minimum wall thicknesses. ** - Type L - Hard *** - Type K - Hard temper with brazed joints only or type K-soft temper without joints in or under floors **** - In or under slab floors only brazed joints				

TABLE III				
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT				
FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
A. STORAGE WATER HEATERS				
Elect.	60 max.		10 CFR 430	EF = 0.93
Elect.	60 min.		10 CFR 430	EF = 0.91
Elect.	20 min.	12 kW max.	10 CFR 430	EF = 0.93-0.00132V minimum
Elect.	20 min.	12 kW max.	ANSI Z21.10.3/CS (Addenda B)	SL = $20+35x(V^{1/2})$ maximum
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				

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 05 15

COMMON PIPING FOR HVAC

02/14

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 GENERAL REQUIREMENTS
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Material and Equipment Qualifications
 - 1.4.2 Alternative Qualifications
 - 1.4.3 Service Support
 - 1.4.4 Manufacturer's Nameplate
 - 1.4.5 Modification of References
 - 1.4.5.1 Definitions
 - 1.4.5.2 Administrative Interpretations
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 INSTRUCTION TO GOVERNMENT PERSONNEL
- 1.7 ACCESSIBILITY

PART 2 PRODUCTS

- 2.1 ELECTRICAL HEAT TRACING
- 2.2 PIPE AND FITTINGS
 - 2.2.1 Type BCS, Black Carbon Steel
 - 2.2.2 Type CPR, Copper
 - 2.2.2.1 Type CPR-A, Copper Above Ground
- 2.3 PIPING SPECIALTIES
 - 2.3.1 Air Separator
 - 2.3.2 Air Vents
 - 2.3.3 Expansion Tank
 - 2.3.4 Dielectric Connections
 - 2.3.5 Expansion Vibration Isolation Joints
 - 2.3.6 Flexible Pipe Connectors
 - 2.3.7 Metallic Expansion Joints
 - 2.3.8 Hose Faucets
 - 2.3.9 Pressure Gages
 - 2.3.10 Sight-Flow Indicators
 - 2.3.11 Sleeve Couplings
 - 2.3.12 Thermometers
 - 2.3.13 Temperature Gauges
 - 2.3.13.1 Stem Cased-Glass
 - 2.3.13.2 Liquid-Filled Dial
 - 2.3.13.3 Thermal Wells
 - 2.3.14 Pump Suction Strainers
 - 2.3.15 Line Strainers, Water Service
 - 2.3.16 Nameplates
- 2.4 VALVES
 - 2.4.1 Ball and Butterfly Valves

- 2.4.2 Drain, Vent, and Gage Cocks
- 2.4.3 Gate Valves (GAV)
- 2.4.4 Globe and Angle Valves (GLV-ANV)
- 2.4.5 Plug Valve
- 2.4.6 Calibrated Balancing Valve
- 2.4.7 Water Temperature Mixing Valve
- 2.4.8 Water Temperature Regulating Valves
- 2.4.9 Water Pressure Reducing Valve
- 2.4.10 Pressure Relief Valve
- 2.4.11 Combination Pressure and Temperature Relief Valves
- 2.4.12 Drain Valves
- 2.4.13 Air Venting Valves
- 2.4.14 Vacuum Relief Valves
- 2.4.15 Nonslam Check Valves (NSV)
- 2.5 MISCELLANEOUS MATERIALS
 - 2.5.1 Safety Valves
 - 2.5.2 Drain Valves
 - 2.5.3 Bolting
 - 2.5.4 Elastomer Caulk
 - 2.5.5 Escutcheons
 - 2.5.6 Flashing
 - 2.5.7 Flange Gaskets
 - 2.5.8 Grout
 - 2.5.9 Pipe Thread Compounds
- 2.6 SUPPORTING ELEMENTS
 - 2.6.1 Building Structure Attachments
 - 2.6.1.1 Anchor Devices, Concrete and Masonry
 - 2.6.1.2 Beam Clamps
 - 2.6.1.3 C-Clamps
 - 2.6.1.4 Inserts, Concrete
 - 2.6.2 Horizontal Pipe Attachments
 - 2.6.2.1 Single Pipes
 - 2.6.2.2 Parallel Pipes
 - 2.6.3 Vertical Pipe Attachments
 - 2.6.4 Hanger Rods and Fixtures
 - 2.6.5 Supplementary Steel

PART 3 EXECUTION

- 3.1 PIPE INSTALLATION
- 3.2 VALVES
- 3.3 AIR VENTS
- 3.4 DRAINS
- 3.5 FLEXIBLE PIPE CONNECTORS
- 3.6 TEMPERATURE GAUGES
- 3.7 SUPPORTING ELEMENTS INSTALLATION
- 3.8 PENETRATIONS
- 3.9 SLEEVES
- 3.10 ESCUTCHEONS
- 3.11 FLASHINGS
- 3.12 HEAT TRACE CABLE INSTALLATION
- 3.13 DISINFECTION
- 3.14 HEAT TRACE CABLE TESTS
- 3.15 OPERATION AND MAINTENANCE
- 3.16 PAINTING OF NEW EQUIPMENT
 - 3.16.1 Factory Painting Systems
 - 3.16.2 Shop Painting Systems for Metal Surfaces

-- End of Section Table of Contents --

SECTION 23 05 15

COMMON PIPING FOR HVAC
02/14

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2017) Steel Construction Manual

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4 (2015; R 2020) Relief Valves for Hot Water Supply Systems

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 B1.20.1 (2013; R 2018) Pipe Threads, General Purpose (Inch)

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 (2016) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.5 (2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.9 (2018) Factory-Made Wrought Butt welding Fittings

ASME B16.22 (2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B16.25 (2017) Butt welding Ends

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 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

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(2020) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1017	(2009) Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems - (ANSI approved 2010)

AMERICAN WELDING SOCIETY (AWS)

AWS 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	(2017a) 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 A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
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 A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM 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	(2012; R 2019) 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	(2020) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C109/C109M	(2020b) 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 D2308	(2007; R 2013) Standard Specification for Thermoplastic Polyethylene Jacket for Electrical Wire and Cable
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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 515 (2017) Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications

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-78 (2011) Cast Iron Plug Valves, Flanged and Threaded Ends

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-DTL-17813 (2009; Rev H; Supp 1 2009; Notice 1 2013) Expansion Joints, Pipe, Metallic Bellows, General Specification for

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.

Include with Equipment Foundation Data for piping systems all plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

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.

Submit Manufacturer's Standard Color Charts for pipes, valves and specialties showing the manufacturer's recommended color and finish selections.

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. 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

Material, Equipment, and Fixture Lists; G,

SD-02 Shop Drawings

Record Drawings; G

Connection Diagrams; G

Coordination Drawings; G

Fabrication Drawings; G

Installation Drawings; G

Water Temperature Mixing Valve; G

Water Temperature Regulating Valves; G

Water Pressure Reducing Valve; G

Pressure Relief Valve; G, AE

Combination Pressure and Temperature Relief Valves; G

SD-03 Product Data

Pipe and Fittings; G,

Piping Specialties; G

Valves; G

Miscellaneous Materials; G

Supporting Elements; G

Equipment Foundation Data; G

Water Temperature Mixing Valve; G

Water Temperature Regulating Valves; G

Water Pressure Reducing Valve; G

Pressure Relief Valve; G

Combination Pressure and Temperature Relief Valves; G

SD-04 Samples

Manufacturer's Standard Color Charts; G

SD-05 Design Data

Pipe and Fittings; G

Piping Specialties; G

Valves; G

SD-06 Test Reports

Hydrostatic Tests; G

Air Tests; G

Valve-Operating Tests; G

Drainage Tests; G

Pneumatic Tests; G

Non-Destructive Electric Tests; G

System Operation Tests; G

SD-07 Certificates

Record of Satisfactory Field Operation; G

List of Qualified Permanent Service Organizations; G

Listing of Product Installations; G

Records of Existing Conditions; G

Surface Resistance; G

Shear and Tensile Strengths; G

Temperature Ratings; G

Bending Tests; G

Flattening Tests; G

Transverse Guided Weld Bend Tests; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Water Temperature Mixing Valve; G

Water Temperature Regulating Valves; G

Water Pressure Reducing Valve; G

Pressure Relief Valve; G

Combination Pressure and Temperature Relief Valves; G

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."

Clean: The industry standard definition of clean is a surface free of mill scale, slag, grease, oil, dirt, and corrosion products. It is necessary to hydrostatically test, flush, clean and chemically pre-treat all new systems using an agent specified by the Agency water treatment contractor on record.

Flush: Any new/old system shall be flushed with clean fresh makeup water until the water coming out of the system is identical in content to the water going into the system. This ensures that any chemical agents used are completely rinsed out of the system and any corrosion products, oils, greases, etc. are removed from the system. The Agency water treatment contractor shall test the water to ensure that the contaminant levels coming out of the system in the effluent are identical to that of the makeup water source. The Agency water treatment contractor shall ensure that all necessary notifications are made to the POTW in accordance with applicable agreements or NPDES permits in advance of flushing. Discharge of flush activities to storm sewer or storm water management feature is prohibited without prior written approval from COR and OHES, after assurances that flush activities are compliant with Federal, state, and installation environmental permit limitations.

Treat: Treat means to chemically pre-treat and passivate the system to ensure that the mill scale, slag, grease, oil, dirt and corrosion products are emulsified and flushed from the system. Treat also connotes chemically treating to ensure that the system is properly protected against microbiological fouling, mineral scaling and corrosion.

Test: All new piping shall be hydrostatically tested to ensure leak-free construction. In some instances, system piping or components may be damaged by excessive pressures. The A/E is responsible for informing the COR of any instances in which the test pressures indicated below may result in harm to new or existing system components.

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 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. Provide instructors thoroughly familiar with all parts of the installation and trained in operating theory as well as practical operation and maintenance work.

Give instruction 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 is 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.

1.7 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 ELECTRICAL HEAT TRACING

Provide heat trace systems for pipes, valves, and fittings that are in accordance with IEEE 515 and be UL listed. System include all necessary components, including heaters and controls to prevent freezing.

Provide self-regulating heaters consisting of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature along its length. Ensure heater is able to be crossed over itself without overheating. Obtain approval before used directly on plastic pipe. Cover heater with a radiation cross-linked modified polyolefin dielectric jacket in accordance with ASTM D2308.

Provide heater with self-regulating factor of at least 90 percent, in order to provide energy conservation and to prevent overheating.

Operate heater on line voltages of 208 volts without the use of transformers.

Size Heater according to the following table:

Pipe Size

(Inch, Diameter)	Minus 10 degrees F	Minus 20 degrees F
3 inches or less	5 watts per foot (wpf)	5 wpf
4 inch	5 wpf	8 wpf
6 inch	8 wpf	8 wpf
8 inch	2 strips/5 wpf	2 strips/8 wpf
12 inch	2 strips/8 wpf	2 strips/8 wpf

Control systems by an ambient sensing thermostat set at 40 degrees F either directly or through an appropriate contactor. Heat tracing must be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.2 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.

2.2.1 Type BCS, Black Carbon Steel

Ensure pipe 1/8 through 12 inches is Schedule 40 black carbon steel, conforming to ASTM A53/A53M.

Ensure pipe 1/8 through 10 inches is Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A53/A53M, Type E, Grade B (electric-resistance welded) . Grade A should be used for permissible field bending, in both cases.

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.

2.2.2 Type CPR, Copper

2.2.2.1 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). Pipe threads shall conform to ASME B1.20.1.

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.

2.3 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.

2.3.1 Air Separator

Air separated from converter discharge water is ejected by a reduced-velocity device vented to the compression tank.

Provide a commercially constructed separator, designed and certified to separate not less than 80 percent of entrained air on the first passage of water and not less than 80 percent of residual on each successive pass. Provide shop drawings detailing all piping connections proposed for this work.

Ensure the air separator is carbon steel, designed, fabricated, tested, and stamped in conformance with ASME BPVC SEC VIII D1 for service pressures not less than 125 psi.

2.3.2 Air Vents

Provide manual air vents at water coils and for HHW unit heaters using 3/8-inch globe valves. 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.

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 A276/A276M. Fit vent with try-cock. Ensure vent discharges air at any pressure up to 150 psi. Ensure outlet is copper tube routed.

Each automatic 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.

2.3.3 Expansion Tank

Tank shall be welded steel, constructed for, and tested to pressure-temperature rating of 125 psi at 150 degrees F in accordance with ASME BPVC SEC VIII D1. Tank shall be equipped with all necessary fittings. Provide tanks precharged to the minimum operating pressure. Tank shall have a replaceable polypropylene or butyl lined diaphragm which keeps the air charge separated from the water; shall be the captive air type. Zinc coat the tank inside and out after fabrication by the hot dip process ASTM A123/A123M

Tanks shall accommodate expanded water of the system generated within the normal operating temperature range, limiting this pressure increase at all components in the system to the maximum allowable pressure at those components. Each tank air chamber shall be fitted with a drain, fill, an air charging valve, and system connections. Tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The only air in the system shall be the permanent sealed-in air cushion contained within the expansion tank.

2.3.4 Dielectric Connections

Electrically insulate dissimilar pipe metals from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.3.5 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 chlorosulphinated 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.

2.3.6 Flexible Pipe Connectors

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 chlorosulphinated 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:

<u>INSIDE DIAMETER</u>	<u>UNIT PIPE LENGTH</u>
To 2-1/2 inches, inclusive	12 inches
3 to 4 inches, inclusive	18 inches
5 to 12 inches, inclusive	24 inches

2.3.7 Metallic Expansion Joints

Provide metallic-bellows expansion joints conforming to MIL-DTL-17813.

Design and construct joints to absorb all of the movements of the pipe sections in which installed, with no detrimental effect on pipe or supporting structure.

Rate, design, and construct joints for pressures to 125 psig and temperatures to 500 degrees F.

Ensure joints have a designed bursting strength in excess of four times their rated pressure.

Ensure joints are capable of withstanding a hydrostatic test of 1.5 times their rated pressure while held at their uncompressed length without leakage or distortion that may adversely affect their life cycle.

Ensure life expectancy is not less than 10,000 cycles.

Ensure movement capability of each joint exceeds calculated movement of piping by 100 percent.

Provide bellows and internal sleeve material of AISI Type 304, 304L, or 321 corrosion-resistant steel.

End connections require no field preparation other than cleaning.

Butt weld end preparation of expansion joints conform to the same codes and standards requirements as applicable to the piping system materials at the indicated joint location.

Flanges of flanged-end expansion joints conforms to the same codes and standard requirements as are applicable to companion flanges specified for

the given piping system at the indicated joint location.

Provide joints, 2-1/2 inches and smaller, with internal guides and limit stops.

Provide joints, 3 inches and larger, with removable external covers, internal sleeves, and purging connection. Size sleeves to accommodate lateral clearance required, with minimum reduction of flow area, and with oversized bellows where necessary. When a sleeve requires a gasket as part of a locking arrangement, provide the gasket used by the manufacturer. Joints without purging connection may be provided; however, remove these from the line prior to, or not installed until, cleaning operations are complete.

Provide the cylindrical end portion of the reinforced bellows element with a thrust sleeve of sufficient thickness to bring that portion within applicable code-allowable stress. Provide 360 degrees support for the element and end-reinforcing ring with the sleeve.

Ensure expansion joints have four, equidistant, permanent tram points clearly marked on each joint end. Locate points to prevent obliteration during installation. Include distance between tram points indicating installed lengths in shop drawings. Overall dimension after joint installation is subject to approval from the Contracting Officer.

Ensure each expansion joint has adjustable clamps or yokes provided at quarter points, straddling the bellows. Overall joint length is set by the manufacturer to maintain joints in manufacturer's recommended position during installation.

Permanently and legibly mark each joint with the manufacturer's name or trademark and serial number; the size, series, or catalog number; bellows material; and directional-flow arrow.

2.3.8 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.

2.3.9 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. 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)

2.3.10 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 316 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.

2.3.11 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.

2.3.12 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. Thermometer range is suitable for system media operating temperature range, 32-212 degrees F. The thermometers shall be provided with readings in degrees F. . Provide thermometers with nonferrous separable wells. Provide lagging extension to accommodate insulation thickness.

2.3.13 Temperature Gauges

Temperature gauges, shall be the industrial duty type and be provided for the required temperature range. Provide gauges with fixed thread connection, dial face gasketed within the case; and an accuracy within 2 percent of scale range. Gauges shall have Fahrenheit scale in 2 degree graduations scale (black numbers) on a white face. The pointer shall be adjustable. Rigid stem type temperature gauges shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type temperature gauges shall be provided in thermal wells located 5 to 7 feet above the finished floor or in locations indicated. Remote element type temperature gauges shall be provided in thermal wells located 7 feet above the finished floor or in locations indicated.

2.3.13.1 Stem Cased-Glass

Stem cased-glass case shall be polished stainless steel or cast aluminum, 9 inches long, with clear acrylic lens, and non-mercury filled glass tube with indicating-fluid column.

2.3.13.2 Liquid-Filled Dial

Liquid-filled dial type cases shall be not less than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill shall be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing shall be double-braided bronze.

2.3.13.3 Thermal Wells

Thermal well shall 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 shall not be used in thermometers. Extended neck thermal wells shall be of sufficient length to clear insulation thickness by 1 inch.

2.3.14 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 differential-pressure gage fitted with a two-way brass cock across the strainer.

Provide manual air vent cocks in cap of each strainer.

2.3.15 Line Strainers, Water Service

Install 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.

2.3.16 Nameplates

Major equipment including pumps, pump motors, expansion tanks, and air separator tanks shall have the manufacturer's name, type or style, model or serial number on a plate secured to the item of equipment. The nameplate of the distributing agent will not be acceptable. Plates shall be durable and legible throughout equipment life and made of stainless steel. Plates shall be fixed in prominent locations with nonferrous screws or bolts.

2.4 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.

2.4.1 Ball and Butterfly Valves

Ensure ball valves conform to MSS SP-72 for Figure 1A, 1 piece body 1B, vertically split body full port 1C, top entry 1D, three piece body 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 E 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.

2.4.2 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.

2.4.3 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.

2.4.4 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.

2.4.5 Plug Valve

Plug valves 2 inches and larger shall conform to MSS SP-78, have flanged or threaded ends, and have cast iron bodies with bronze trim. Valves 2 inches and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valve shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type. Valve shall be resilient, double seated, trunnion mounted with tapered lift plug capable of 2-way shutoff. Valve shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug. Valves 8 inches or larger shall be provided with manual gear operators with position indicators.

2.4.6 Calibrated Balancing Valve

Copper alloy or cast iron body, copper alloy or stainless internal working parts. Provide valve calibrated so that flow can be determined when the temperature and pressure differential across valve is known. Valve shall have an integral pointer which registers the degree of valve opening. Valve shall function as a service valve when in fully closed position. Valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation.

Provide valve bodies with tapped openings and pipe extensions with positive shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable differential pressure meter connections to verify the pressure differential. Provide metal tag on each valve showing the gallons per

minute flow for each differential pressure reading.

2.4.7 Water Temperature Mixing Valve

Valve, ASSE 1017 for water service.

2.4.8 Water Temperature Regulating Valves

Provide copper alloy body, direct acting, pilot operated, for the intended service.

2.4.9 Water Pressure Reducing Valve

Valve, ASSE 1003 for water service, copper alloy body.

2.4.10 Pressure Relief Valve

Valve shall prevent excessive pressure in the piping system when the piping system reaches its maximum heat buildup. Valve, ANSI Z21.22/CSA 4.4 and shall have cast iron bodies with corrosion resistant internal working parts. The discharge pipe from the relief valve shall be the size of the valve outlet unless otherwise indicated.

2.4.11 Combination Pressure and Temperature Relief Valves

ANSI Z21.22/CSA 4.4, copper alloy body, automatic re-seating, test lever, and discharge capacity based on AGA temperature steam rating.

2.4.12 Drain Valves

Valves, MSS SP-80 gate valves. Valve shall be manually-operated, 3/4 inch pipe size and above with a threaded end connection. Provide valve with a water hose nipple adapter. Freeze-proof type valves shall be provided in installations exposed to freezing temperatures.

2.4.13 Air Venting Valves

Manually-operated general service type air venting valves, brass or bronze valves that are furnished with threaded plugs or caps. Automatic type air venting shall be the ball-float type with brass/bronze or brass bodies, 300 series corrosion-resistant steel float, linkage and removable seat. Air venting valves on water coils shall have not less than 1/8 inch threaded end connections. Air venting valves on water mains shall have not less than 3/4 inch threaded end connections. Air venting valves on all other applications shall have not less than 1/2 inch threaded end connections.

2.4.14 Vacuum Relief Valves

ANSI Z21.22/CSA 4.4

2.4.15 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 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.

2.5 MISCELLANEOUS MATERIALS

Submit equipment and performance data for miscellaneous materials consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

2.5.1 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 the nearest mechanical room floor drain, or a location as indicated. Each discharge pipe for hot water service shall be pitched away from the valve seat.

2.5.2 Drain Valves

Indicate the location of each drain valve on the design drawings. Indicate if a drain valve is freeze-proof. Indicate whether a manual or automatic air venting valve. Delete freeze-proof drain valve specification if not required.<

Valve shall be manually-operated, 3/4 inch pipe size and above with a threaded end connection. Provide valve with a water hose nipple adapter. Freeze-proof type valves shall be provided in installations exposed to freezing temperatures.

2.5.3 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.

2.5.4 Elastomer Caulk

Use two-component polysulfide- or polyurethane-base elastomer caulking material, conforming to ASTM C920.

2.5.5 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.

2.5.6 Flashing

Ensure sheetlead conforms to ASTM B749, UNS Alloy Number L51121 (for use where lead sheet of high purity and improved structural strength is indicated).

Ensure sheet copper conforms to ASTM B370 and be not less than 16 ounces per square foot weight.

2.5.7 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.

2.5.8 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

2.5.9 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.

2.6 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.

2.6.1 Building Structure Attachments

Use appropriate MSS SP-58 Type anchor or support device required for each application as specified.

2.6.1.1 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.

2.6.1.2 Beam Clamps

Ensure beam clamps are center-loading MSS SP-58 Type 20, 21, 28, 29, 30.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, MSS SP-58 Type 19 20 25 27 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.

2.6.1.3 C-Clamps

Do not use C-clamps.

2.6.1.4 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.

Do not use powder actuated inserts on concrete less than 4 inches thick. Submit locations powder actuated inserts are intended for approval before use.

2.6.2 Horizontal Pipe Attachments

2.6.2.1 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, 3, 4 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, 44 through 46, 49 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.

2.6.2.2 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 and be of commercially available, proprietary design, rolled steel.

2.6.3 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.

2.6.4 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.

2.6.5 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

Provide black steel schedule 40 steel pipe with threaded joints and fittings for 2 inches and smaller and with flanged or welded joints for 2 1/2 inches and larger.

Provide Type K, drawn copper tubing with wrought copper fittings and solder joints for condensate drain piping, above ground, within building.

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.

The Contractor shall prepare a script based upon these Specifications and submit to the Government as a Shop Drawing for approval. All procedures must be approved and witnessed by the COR, PM, Operations personnel and the Agency water treatment contractor. The following requirements shall be completed in the 1-6 sequence:

1. Wash and wipe the exterior of all new piping to remove construction dirt, loose scale and flux before bringing the pipe indoors.
2. Each piece of installed or existing-to-remain (ETR) equipment (such as coils, evaporators, condensers or heat exchangers) shall have a valved bypass installed just prior to the equipment. Each piece of equipment shall be either valved or sealed off utilizing frying pan type blanks to prevent contaminated water, dirt, scale or debris from entering this equipment. Where bypasses are not installed, remove piping spool pieces between equipment isolation valves / blanks and provide temporary pipe bypasses, as required. Blowdowns on low points shall also be utilized.
3. Piping shall be tested at 150 psi, or 1.5 times highest design pressure with all piping and joints proven to be leak-free prior to approval by the Government Representative(s). For piping 4" and below, test for 4 hours. For piping 6" and above, test for 8 hours. Pressure

testing tolerance shall be plus/minus zero psig. All air must be vented from the piping prior to the test. In addition, every isolatable section shall be separately tested to ensure the closed valves hold under the test conditions mentioned previously except with 1/2 hour intervals.

4. Fill water used during testing and final filling shall be supplied from an external water source (use of system water is not permitted). This water must be properly treated prior to being introduced to new or existing systems. The contractor must coordinate with the Agency water treatment contractor to ensure that the water is compatible with the system materials of construction and existing water treatment program. Air testing will not be acceptable as a documented test but may be used for pre-tests. Once hydro testing is complete, water is to be drained and flushing is to occur within 48 hours of hydro testing.

Clean the interior of all new closed water system (not open to atmosphere) piping using a neutral HEPD/polymer/sulfite based liquid compound with emulsifying agents and detergents. Ensure that all chemicals are compatible with both the system materials of construction and the existing water treatment program.

6. Flush the system to remove any debris that either existed before or was caused by construction. To ensure that larger debris is removed from the system, minimum velocities as defined below must be achieved during the flushing procedure. Pipe velocities shall be measured in new piping segments using portable ultrasonic flow meters and verified by the Government Representative(s).

The Contractor may employ the following methods to perform this work (In order of preference):

- a. Provide temporary pumps to achieve the minimum flow requirements defined above. Stainless steel construction strainers (minimum 10 mesh to protect pump) shall be utilized during the procedure. Strainers must be designed to perform at pipe velocity listed in above chart. The A/E must ensure that the taps and by bypass of adequate sizing are included in new sections of pipe to facilitate these velocities.

- b. If system design does not permit for use of temporary pumps, then new bearings, seals and gaskets will be transferred to owner for ALL pumps utilized for flushing.

- c. If the system pump(s) are used to achieve the minimum flow requirements defined above, stainless steel construction strainers (minimum 3/32-inch mesh) shall be installed to protect the pump(s) during the procedure. The Contractor will be responsible for all costs (parts and labor) to repair pumps damaged as a result of this work.

During water circulation, remove foreign matter by draining at low points and equipment inlets. Ensure the desired drain flow does not exceed system water makeup capability. When the system appears to be free of foreign matter (water runs clear), shut the pumps down, remove the construction strainers, and inspect and clean the strainers by removing any foreign matter before re-installing. Repeat this process until the system is determined by the Government Representative(s) to be clean and free of debris. Duration of flushing and circulation shall be minimum 24 hours, or as required by the water treatment

contractor.

i. The water treatment contractor shall test the water to ensure that the contaminant levels coming out of the system in the effluent are identical to that of the makeup water source, in accordance with AWWA-C651.

Once the system is determined to be clean, close the equipment bypass valves, remove any previously installed frying pan type blanks, remove any temporary bypasses, reinstall pipe spool pieces, and fill and vent emptied portions of the system, open equipment isolation valves and restart the pumps. Re-circulate water through the equipment strainers, evaporators, condensers, heat exchangers and cooling towers. Remove dead legs created by by-pass piping. After circulating water for four (4) hours, shut the system down, turn the valve off and drain the equipment. Remove all evaporator, condenser and heat exchanger water box covers for visual water box and tube inspection. Clean tubes found to be fouled or obstructed with new or existing debris. Repeat this process until strainers, evaporators, condensers and heat exchangers are determined to be clean by the Government Representative(s). When complete, replace the water box cover gaskets on all equipment. Flushing water shall be piped to the sanitary sewer system (discharge to the storm water system is not permitted).

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 with dielectric couplings (or unions) rated for the service.

Make final connections to equipment with unions or flanges provided every 100 feet of straight run. Provide 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.

Provide 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.

Make piping systems butt weld joints with backing rings. Use compatible backing ring materials with materials being joined. Ensure joint configuration conforms to ASME B16.25.

Accomplish preheat and postheat treatment of welds in accordance with ASME BPVC SEC IX and ASME B31.3.

Take all necessary precautions during installation of flexible pipe and hose including flushing and purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Ensure installation conforms to manufacturer's instructions.

3.2 VALVES

Provide ball valves in piping mains and all branches and at equipment where indicated and as specified. Provide ball valves for applications 2 inches and smaller applications, and butterfly valve for applications 2 1/2 inches and larger.

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system.

Provide 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.

Provide 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 AIR VENTS

Air vents shall be provided at all high points, on all unit heater water coils, and where indicated to ensure adequate venting of the piping system.

3.4 DRAINS

Drains shall be provided at all low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.5 FLEXIBLE PIPE CONNECTORS

Connectors shall be attached to components in strict accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the flexible pipe connector manufacturer and shall be provided at the intervals recommended.

3.6 TEMPERATURE GAUGES

Temperature gauges shall be located on supply and return piping at each heat exchanger, on condenser water piping entering and leaving a

condenser, at each automatic temperature control device without an integral thermometer, and where indicated or required for proper operation of equipment. Thermal wells for insertion thermometers and thermostats shall extend beyond thermal insulation surface not less than 1 inch.

3.7 SUPPORTING ELEMENTS INSTALLATION

Provide 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 hangers 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:

<u>PIPE SIZE</u> <u>INCHES</u>	<u>ROD SIZE</u> <u>INCHES</u>	<u>STEEL PIPE</u> <u>FEET</u>	<u>COPPER PIPE</u> <u>FEET</u>
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

Provide vibration isolation supports where needed. Refer to Section 23 05 48.19 BRACING FOR HVAC where A/C equipment and piping is installed.

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, provide 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.

3.8 PENETRATIONS

Provide 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.

3.9 SLEEVES

Provide sleeves where piping passes through roofs, masonry, concrete walls and floors.

Continuously weld 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). Provide 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.

Ensure sleeve height above roof surface is a minimum of 12 and a maximum of 18-inches.

3.10 ESCUTCHEONS

Provide escutcheons at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, provide 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.

3.11 FLASHINGS

Provide flashings at penetrations of building boundaries by mechanical systems and related work.

3.12 HEAT TRACE CABLE INSTALLATION

Field apply heater tape and cut to fit as necessary, linearly along the length of pipe after piping has been pressure tested and approved by the Contracting Officer. Secure the heater to piping with cable ties. Label thermal insulation on the outside, "Electrical Heat Trace."

Install power connection, end seals, splice kits and tee kit components in accordance with IEEE 515 to provide a complete workable system. Terminate connection to the thermostat and ends of the heat tape in a junction box. Ensure cable and conduit connections are raintight.

3.13 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).

Resident water treatment contractor shall be consulted during design and specified during construction to recommend the proper course of action and proper chemistry requirements based upon the system metallurgy on hand. The industry standard definition of clean is a surface free of mill scale, slag, grease, oil, dirt, and corrosion products. All piping systems shall be specified to be chemically pre-treated using an agent in compliance with the Agency water treatment contractor standards.

Any new/old system shall be specified to be flushed with clean fresh makeup water until the water coming out of the system is identical in content to the water going into the system. This ensures that any chemical agents used are completely rinsed out of the system and any corrosion products, oils, greases, etc. are removed from the system.

Resident water treatment contractor shall test the water to ensure that the contaminant levels coming out of the system in the effluent are identical to that of the makeup water source, in accordance with AWWA-C651.

Treat means to chemically pre-treat and passivate the system to ensure that the mill scale, slag, grease, oil, dirt and corrosion products are emulsified and flushed from the system. Treat also means chemically treating to ensure that the system is properly protected against microbiological fouling, mineral scaling and corrosion.

Piping shall be specified to be cleaned, flushed, treated and hydrostatically tested to ensure clean, flushed, treated and leak-free construction prior to Government acceptance.

For Government buildings the AHJ shall be the COR. For leased facilities the AHJ shall be the local plumbing inspector and the requirements shall be adjusted as required to comply with the local jurisdiction.

The Contractor shall prepare a script based upon these Specifications and submit to the Government as a Shop Drawing for approval. All procedures must be approved and witnessed by the COR, PM, Operations personnel and the Agency water treatment contractor.

1. Wash and wipe the exterior of all new piping to remove construction dirt, loose scale and flux before bringing the pipe indoors.
2. Each piece of equipment (such as coils, evaporators, condensers or heat exchangers) shall have a valved bypass installed just prior to the equipment. Each piece of equipment shall be either valved or sealed off utilizing frying pan type blanks to prevent contaminated water, dirt, scale or debris from entering this equipment. Where bypasses are not installed, remove piping spool pieces between equipment isolation valves / blanks and provide temporary pipe bypasses, as required. Blowdowns on low points shall also be utilized.
3. Each piece of equipment (such as coils, evaporators, condensers or heat exchangers) shall have a valved bypass installed just prior to the equipment. Each piece of equipment shall be either valved or sealed off utilizing frying pan type blanks to prevent contaminated water, dirt, scale or debris from entering this equipment. Where bypasses are not installed, remove piping spool pieces between equipment isolation valves / blanks and provide temporary pipe bypasses, as required. Blowdowns on low points shall also be utilized.
4. Fill water used during testing and final filling shall be supplied from an external water source (use of system water is not permitted). This water must be properly treated prior to being introduced to new or existing systems. The contractor must coordinate with the Agency water treatment contractor to ensure that the water is compatible with the system materials of construction and existing water treatment program. Air testing will not be acceptable as a documented test but may be used for pre-tests. Once hydro testing is complete, water is to be drained and flushing is to occur within 48 hours of hydro testing.
5. Clean the interior of all new closed water system (not open to atmosphere) piping using a neutral HEPD/polymer/sulfite based liquid compound with emulsifying agents and detergents. Ensure that all chemicals are compatible with both the system materials of

construction and the existing water treatment program.

6. Flush the system to remove any debris that either existed before or was caused by construction. To ensure that larger debris is removed from the system, minimum velocities as defined below must be achieved during the flushing procedure. Pipe velocities shall be measured in new piping segments using portable ultrasonic flow meters and verified by the Government Representative(s).

Pipe Size (Inches)	Minimum Water Velocity (ft/second)
1	6
2	6
3	6
4	6
5	7
6	8
8	9
10 or larger	10

The Contractor may employ the following methods to perform this work (In order of preference):

1. Provide temporary pumps to achieve the minimum flow requirements defined above. Stainless steel construction strainers (minimum 10 mesh to protect pump) shall be utilized during the procedure. Strainers must be designed to perform at pipe velocity listed in above chart. The A/E must ensure that the taps and by bypass of adequate sizing are included in new sections of pipe to facilitate these velocities.
2. If system design does not permit for use of temporary pumps, then new bearings, seals and gaskets will be transferred to owner for ALL pumps utilized for flushing.
3. If the system pump(s) are used to achieve the minimum flow requirements defined above, stainless steel construction strainers (minimum 3/32-inch mesh) shall be installed to protect the pump(s) during the procedure. The Contractor will be responsible for all costs (parts and labor) to repair pumps damaged as a result of this work.

During water circulation, remove foreign matter by draining at low points and equipment inlets. Ensure the desired drain flow does not exceed system water makeup capability. When the system appears to be free of foreign matter (water runs clear), shut the pumps down, remove the construction strainers, and inspect and clean the strainers by removing any foreign matter before re-installing. Repeat this process until the system is determined by the Government Representative(s) to be clean and free of debris. Duration of flushing and circulation shall be minimum 24 hours, or as required by the water treatment contractor.

a. The water treatment contractor shall test the water to ensure that the contaminant levels coming out of the system in the effluent are identical to that of the makeup water source, in accordance with AWWA-C651.

Once the system is determined to be clean, close the equipment bypass valves, remove any previously installed frying pan type blanks, remove any temporary bypasses, reinstall pipe spool pieces, and fill and vent emptied portions of the system, open equipment isolation valves and restart the pumps. Re-circulate water through the equipment strainers, evaporators, condensers, heat exchangers and cooling towers. Remove dead legs created by by-pass piping. After circulating water for four (4) hours, shut the system down, turn the valve off and drain the equipment. Remove all evaporator, condenser and heat exchanger water box covers for visual water box and tube inspection. Clean tubes found to be fouled or obstructed with new or existing debris. Repeat this process until strainers, evaporators, condensers and heat exchangers are determined to be clean by the Government Representative(s). When complete, replace the water box cover gaskets on all equipment. Flushing water shall be piped to the sanitary sewer system (discharge to the storm water system is not permitted).

3.14 HEAT TRACE CABLE TESTS

Test heat trace cable system in accordance with IEEE 515 after installation and before and after installation of the thermal insulation. Test heater cable using a 1000 vdc megger. Minimum insulation resistance is 20 to 1000 megohms regardless of cable length.

3.15 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.

3.16 PAINTING OF NEW EQUIPMENT

Factory or shop apply new equipment painting, as specified herein, and provided under each individual section.

3.16.1 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.

3.16.2 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 --

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 05 48.19

BRACING FOR HVAC

05/18, CHG 2: 08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
 - 1.2.1 General Requirements
 - 1.2.2 Contractor Designed Bracing
 - 1.2.3 Items Not Covered By This Section
 - 1.2.3.1 Fire Protection Systems
- 1.3 SUBMITTALS

PART 2 PRODUCTS

- 2.1 GENERAL DESIGN REQUIREMENTS
- 2.2 EQUIPMENT RESTRAINT
 - 2.2.1 Rigidly (Base and Suspended) Mounted Equipment
 - 2.2.2 Nonrigid or Flexibly-Mounted Equipment
- 2.3 BOLTS AND NUTS
- 2.4 FLEXIBLE JOINTS
 - 2.4.1 Braided Hose Expansion Joint
 - 2.4.1.1 Corrugated Hose
 - 2.4.1.2 Flexible Hose Expansion Loops
 - 2.4.2 Double Ball Flexible Expansion Joint
 - 2.4.2.1 Internal Surfaces
 - 2.4.2.2 Exterior Surfaces
 - 2.4.3 Double Ball Flexible Expansion Joint Gravity Drain
(Non-Pressurized)

PART 3 EXECUTION

- 3.1 COUPLING AND BRACING
- 3.2 FLEXIBLE COUPLINGS OR JOINTS
 - 3.2.1 Building Piping
 - 3.2.2 Underground Piping
- 3.3 PIPE SLEEVES
- 3.4 BRACES FOR PIPING
 - 3.4.1 Vertical Runs
 - 3.4.2 Clamps and Hangers
- 3.5 BRACES FOR DUCTS
 - 3.5.1 Braced Ducts
 - 3.5.2 Unbraced Ducts
- 3.6 EQUIPMENT
 - 3.6.1 General
- 3.7 ANCHOR BOLTS
 - 3.7.1 Cast-in-Place Anchor Bolts
 - 3.7.2 Drilled-In Anchor Bolts
 - 3.7.2.1 Wedge Anchors, Heavy-Duty Sleeve Anchors, and Undercut

- Anchors
 - 3.7.2.2 Cartridge Injection Adhesive Anchors
 - 3.7.2.3 Capsule Anchors
- 3.8 ANCHOR BOLT TESTING
 - 3.8.1 Torque Wrench Testing
 - 3.8.2 Pullout Testing

-- End of Section Table of Contents --

SECTION 23 05 48.19

BRACING FOR HVAC
05/18, 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 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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- AWWA C105/A21.5 (2018) Polyethylene Encasement for Ductile-Iron Pipe Systems
- AWWA C116/A21.16 (2015) Protective Fusion-Bonded Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray Iron Fittings
- AWWA C153/A21.53 (2019) Ductile-Iron Compact Fittings for Water Service
- AWWA C213 (2015) Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines

ASTM INTERNATIONAL (ASTM)

- 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 A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2665	(2014) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM E488/E488M	(2015) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F891	(2016) Standard Specification for Coextruded Poly (Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
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
------------	---

ICC EVALUATION SERVICE, INC. (ICC-ES)

ICC ES AC193	(2012) Acceptance Criteria for Mechanical Anchors in Concrete Elements
--------------	---

NSF INTERNATIONAL (NSF)

NSF/ANSI 61	(2020) Drinking Water System Components - Health Effects
-------------	---

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 3-301-02	(2020) Design of Risk Category V

Structures, National Strategic Military Assets

UFC 4-010-01

(2018;with Change 1, 2020) DoD Minimum Antiterrorism Standards for Buildings

VIBRATION ISOLATION AND SEISMIC CONTROL MANUFACTURERS ASSOCIATION (VISCMA)

VISCMA 412

(2014) Installing Seismic Restraints for Mechanical Equipment

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Apply the requirements for bracing 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.

Mechanical equipment, ductwork, piping and associated controls conduit must not be supported from overhead concrete filled metal decks, bare metal decks, or metal trays. Provide supports from structural framing.

Concrete anchors and attachments included in this section are intended for utilization where attachment to structural framing is not possible. Provide scale layout and expected anchor sizing and carrying capacity calculations for wherever this occurs for approval.

1.2.2 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. Design the bracing in accordance with UFC 3-301-01, UFC 3-301-02, UFC 4-010-01. Resistance to lateral forces induced by earthquakes must be accomplished without consideration of friction resulting from gravity loads. UFC 3-301-01 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas must be required. Loadings determined using UFC 3-301-01 are based on strength design; therefore, AISC 325 Specifications must be used for the design. The bracing for the mechanical equipment designated in paragraph 1.2.2 and systems designated in paragraph 1.2.3 must be developed by the Contractor.

1.2.3 Items Not Covered By This Section

1.2.3.1 Fire Protection Systems

Install bracing of piping for fire protection systems as specified in 21 13 13 WET PIPE SPRINKLER SYSTEMS, FIRE PROTECTION, .

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 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

Coupling and Bracing; G

Flexible Couplings or Joints; G

Equipment Restraint; G

Contractor Designed Bracing; G

SD-03 Product Data

Coupling and Bracing; G

Flexible Couplings Or Joints; G

Equipment Restraint; G

Contractor Designed Bracing; G

Anchor Bolts; G

Vibration Isolators; G

SD-05 Design Data

Design Calculations; G

SD-06 Test Reports

Anchor Bolts; G

PART 2 PRODUCTS

2.1 GENERAL DESIGN REQUIREMENTS

Submit detailed bracing 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. Design must be based on actual equipment and system layout. Design must include calculated dead loads, static bracing loads and capacity of materials utilized for the connection of the equipment or system to the structure. Analysis must detail anchoring methods.

Bracing specified in this section must comply with UFC 4-010-01 DoD Minimum Antiterrorism Standards for Buildings, paragraph 3-20 Standard 19. Equipment Bracing Equipment mounted overhead weighing 31 pounds (14 kilograms) or more (excluding distributed systems such as suspended ceilings that collectively exceed that weight) must be mounted using either rigid or flexible systems as described in this section.

Mount all such systems so that they resist forces of 0.5 times the component weight in any horizontal direction and 1.5 times the component weight in the downward direction. This standard does not include the need to design architectural feature mountings for forces required by other criteria.

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.

Roof mounted equipment such as utility exhaust fans and upblast exhaust fans, both vibration isolated and nonisolated, must have support members designed and anchored to building structural steel or concrete as required for wind loads.

2.2.1 Rigidly (Base and Suspended) Mounted Equipment

Base mounted HVAC equipment furnished under this contract must be rigidly mounted using cast-in-place anchor bolts or post-installed anchors that are qualified for earthquake loading in accordance with ACI 355.2 and ACI 355.4. Anchor bolts must conform to ASTM F1554. 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 HVAC equipment furnished under this contract must be attached to supplemental support framing or to building structural steel. There must be no attachment to concrete filled metal deck or bare metal deck. 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.

Roof mounted HVAC equipment roof curbs, framing and attachment to equipment and structure must be designed and braced to withstand seismic loads. .

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 restrained isolators for equipment subject to load variations and large external forces. The housing must be sized to meet or exceed the force requirements applicable to the

project and meet the required isolation criteria. Spring vibration isolator manufacturer's will be a member of VISCMA. Design force, F_p , must be doubled for vibration isolators with an air gap greater than 0.25 inches as specified in ASCE 7-16, Chapter 13. .

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.

2.4.1 Braided Hose Expansion Joint

Braided hose expansion joint(s) must be installed in the locations indicated on the drawings and as required to accommodate any thermal expansion, contraction of the piping system. Joints must consist of two parallel sections of corrugated metal hose, compatible braid, and 180 degree return bend with inlet and outlet connections. Field fabricated loops are not acceptable. Braided hose expansion joint(s) must be installed in the locations indicated on the drawings and as required to accommodate any thermal expansion, contraction of the piping system. Joints must consist of two parallel sections of corrugated metal hose, compatible braid, and 180 degree return bend with inlet and outlet connections. Field fabricated loops must not be acceptable. Braided hose in a 60 degree flexible V loop arrangement must be used for small diameter pipe connections to coils in variable-air-volume (VAV) terminal units and fan coil units installed in suspended ductwork whether braced or unbraced.

All braided hose expansion joints must be manufactured in accordance with the documented manufacturers weld procedure specifications. The procedure qualification record must be used to document the execution of this procedure and must follow the general "guidelines" of ASME Section IX. Each individual welder must conform to the in-house procedure qualification record and be qualified prior to each production lot. The testing of each individual welder must be documented in a welding procedure qualification record.

2.4.1.1 Corrugated Hose

Corrugated hose must be Type 316 stainless steel. Braid must be Type 304 stainless steel for any series 300 stainless steel hose . Fittings materials of construction and end fitting type must be consistent with pipe material and equipment/ pipe connection fittings. Copper fittings must not be attached to stainless steel hose.

2.4.1.2 Flexible Hose Expansion Loops

Flexible hose expansion loops must have a factory supplied, hanger / support lug located at the bottom of the 180deg return. Flexible hose expansion loop(s) must be furnished with a plugged FPT to be used for a drain or air release vent. Flexible hose expansion loop(s) must be rated with an operating pressure which is the same as the adjoining pipe. The operating pressure must be based on burst pressure with a 4 to 1 safety

factor.

2.4.2 Double Ball Flexible Expansion Joint

Install flexible expansion joints manufactured of ductile iron conforming to the material requirements of ASTM A536 and AWWA C153/A21.53 in the locations indicated on the drawings. Provide foundry certification of material upon request. Each flexible expansion joint must be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 2 inch and 30 inches diameter and larger.) A minimum 2:1 safety factor, determined from the published pressure rating, must apply. Factory Mutual Approval for the 3 inch through 12 inch sizes is required. Each flexible expansion joint must consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20°, 2" - 12"; 15°, 14" - 36"; 12°, 42"-48" and 4-inches minimum expansion. Additional expansion sleeves must be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections must be available.

2.4.2.1 Internal Surfaces

Line all internal surfaces (wetted parts) with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213. Sealing gaskets must be constructed of EPDM. The coating must meet NSF/ANSI 61.

2.4.2.2 Exterior Surfaces

Coat exterior surfaces with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C116/A21.16. Include appropriately sized polyethylene sleeves, meeting AWWA C105/A21.5, for direct buried applications.

2.4.3 Double Ball Flexible Expansion Joint Gravity Drain (Non-Pressurized)

Flexible expansion joints gravity drain must be installed in the locations indicated on the drawings and must be manufactured of pvc. All connections whether solvent weld or mechanical must be restrained to allow movement to be transferred to expansion joint. Each ball must allow up to 15 degrees deflection.

End connection outside diameters must be compatible with ASTM D1785, ASTM D2665 and ASTM F891 PVC pipe and are to be solvent welded.

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.

3.2.2 Underground Piping

Install flexible coupling in underground piping and 4 inch or larger conduit, except heat distribution system, where the piping enters the building. Provide couplings that accommodate 2 inches of relative movement between the pipe and the building in any direction. Provide additional flexible couplings where shown on the drawings.

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 BRACES FOR PIPING

Provide braces to prevent movement of the pipes . 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. F

3.4.1 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. Attach sway braces to the structural system. Do not connect to branch lines, walls, or floors.

3.4.2 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 bracing applications. Do not weld vertical braces to hanger rods.

3.5 BRACES FOR DUCTS

3.5.1 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.

3.5.2 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.

3.6 EQUIPMENT

3.6.1 General

Ensure housekeeping pads have adequate space to mount equipment and vibration isolation 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 pads 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.

3.7 ANCHOR BOLTS

3.7.1 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.

3.7.2 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.

3.7.2.1 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.

3.7.2.2 Cartridge Injection Adhesive Anchors

Where approved for bracing and anchoring 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.

3.7.2.3 Capsule Anchors

Where approved for bracing and anchoring 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.

3.8 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.

3.8.1 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 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.

3.8.2 Pullout Testing

Test expansion and chemically bonded anchors by applying a pullout load using a hydraulic ram attached to the anchor bolt. Testing must be in accordance with ASTM E488/E488M or ICC ES AC193. At least 10 percent of each type and size of anchors, but not less than 3 per day must be tested. Apply the load to the anchor without removing the nut; when that is not possible, the nut must be removed and a threaded coupler must be installed of the same tightness as the original nut. Check the test setup to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus must be at least 1.5 times the embedment length away from the bolt being tested. Load each tested anchor to 1 times the design tension value for the anchor. The anchor must have no observable movement at the test load. If any anchor fails the test, similar type and size anchors not previously tested must be tested until 10 percent of those type consecutive anchors pass. Remove and replace failed anchors. Fill empty anchor holes and patch failed anchor locations with high-strength non-shrink, nonmetallic grout.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

11/15

PART 1 GENERAL

- 1.1 RELATED REQUIREMENTS
- 1.2 REFERENCES
- 1.3 DEFINITIONS
 - 1.3.1 Similar Terms
- 1.4 WORK DESCRIPTION
 - 1.4.1 Air Distribution Systems
 - 1.4.2 Water Distribution Systems
 - 1.4.3 Domestic Hot Water Distribution Systems
 - 1.4.4 TAB SCHEMATIC DRAWINGS
- 1.5 SUBMITTALS
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Independent TAB Agency and Personnel Qualifications
 - 1.6.2 TAB Standard
 - 1.6.3 Qualifications
 - 1.6.3.1 TAB Firm
 - 1.6.3.2 TAB Specialist
 - 1.6.3.3 TAB Specialist Responsibilities
 - 1.6.3.4 TAB Related HVAC Submittals
 - 1.6.4 Responsibilities
 - 1.6.4.1 Contractor
 - 1.6.4.2 TAB Agency
 - 1.6.4.3 TAB Team Supervisor
 - 1.6.4.4 TAB Team Field Leader
 - 1.6.5 Test Reports
 - 1.6.5.1 Data from DALT Field Work
 - 1.6.5.2 Certified TAB Reports
- 1.7 SEQUENCING AND SCHEDULING
 - 1.7.1 Projects with Phased Construction
 - 1.7.1.1 Phasing of Work
 - 1.7.2 DALT and TAB Submittal and Work Schedule
 - 1.7.2.1 TAB Design Review Report
 - 1.7.2.2 Pre-Field DALT Preliminary Notification
 - 1.7.2.3 TAB Pre-Field Engineering Report
- 1.8 WARRANTY

PART 2 PRODUCTS

PART 3 EXECUTION

- 3.1 WORK DESCRIPTIONS OF PARTICIPANTS
- 3.2 PRE-DALT/TAB MEETING
- 3.3 DALT PROCEDURES
 - 3.3.1 Instruments, Consumables and Personnel

- 3.3.2 Advance Notice of Pre-Final DALT Field Work
- 3.3.3 Ductwork To Be DALT'd
- 3.3.4 DALT Testing
- 3.3.5 Completed Pre-Final DALT Report
- 3.3.6 Quality Assurance - COTR DALT Field Acceptance Testing
- 3.3.7 Additional COTR Field Acceptance Testing
- 3.3.8 Certified Final DALT Report
- 3.3.9 Prerequisite for TAB Field Work
- 3.4 TAB PROCEDURES
 - 3.4.1 TAB Field Work
 - 3.4.2 Preliminary Procedures
 - 3.4.3 TAB Air Distribution Systems
 - 3.4.3.1 Units With Coils
 - 3.4.3.2 Air Handling Units
 - 3.4.3.3 Air Conditioning Units
 - 3.4.3.4 Return Air Fans
 - 3.4.3.5 Exhaust Fans
 - 3.4.3.6 Unit Heaters
 - 3.4.3.7 Cabinet Unit Heaters
 - 3.4.4 TAB Water Distribution Systems
 - 3.4.4.1 Heating Hot Water
 - 3.4.4.2 Domestic Hot Water System
 - 3.4.5 Sound Measurement Work
 - 3.4.5.1 Areas To Be Sound Measured
 - 3.4.5.2 Procedure
 - 3.4.5.3 Timing
 - 3.4.5.4 Meters
 - 3.4.5.5 Calibration
 - 3.4.5.6 Background Noise Correction
 - 3.4.6 TAB Work on Performance Tests With Seasonal Limitations
 - 3.4.6.1 Performance Tests
 - 3.4.6.2 Season Of Maximum Load
 - 3.4.6.3 Ambient Temperatures
 - 3.4.6.4 Sound Measurements
 - 3.4.6.5 Air Cooled Direct Expansion Units
 - 3.4.6.6 Coils
 - 3.4.7 Workmanship
 - 3.4.8 Deficiencies
 - 3.4.9 TAB Reports
 - 3.4.10 Quality Assurance - COTR TAB Field Acceptance Testing
 - 3.4.10.1 TAB Field Acceptance Testing
 - 3.4.10.2 Additional COTR TAB Field Acceptance Testing
 - 3.4.10.3 Prerequisite for Approval
- 3.5 MARKING OF SETTINGS
- 3.6 MARKING OF TEST PORTS

-- End of Section Table of Contents --

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC
11/15

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

Equipment or systems specified in this section are part of the commissioning process. Refer to Section 01 91 00.15, TOTAL BUILDING COMMISSIONING for additional requirements.

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.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S1.4 (1983; Amendment 1985; R 2006)
Specification for Sound Level Meters (ASA 47)

ASA S1.11 PART 1 (2014) American National Standard
Electroacoustics - Octave-Band and
Fractional-Octave-Band Filters - Part 1:
Specifications

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 203 (1990; R 2011) Field Performance
Measurements of Fan Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 62.1 (2010) Ventilation for Acceptable Indoor
Air Quality

ASHRAE HVAC APP IP HDBK (2016) HVAC Applications Handbook, I-P
Edition

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

1.3 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

1.3.1 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

1.4 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of 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.

1.4.1 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.

1.4.2 Water Distribution Systems

TAB system in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd.

Terminate piping insulation immediately adjacent to each flow control valve, automatic control valve, or device. Seal the ends of pipe insulation and the space between ends of pipe insulation and piping, with waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.4.3 Domestic Hot 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.

1.4.4 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.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Records of Existing Conditions; G

TAB Firm; G

Designation of TAB Team Assistants; G

Designation of TAB Team Engineer; G or TAB Specialist; G

Designation of TAB Team Field Leader; G

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

SD-03 Product Data

Equipment and Performance Data; G

TAB Related HVAC Submittals; G

A list of the TAB Related HVAC Submittals, no later than 7 days

after the approval of the TAB team engineer and assistant.

TAB Procedures; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration; G

Systems Readiness Check; G

TAB Execution; G

TAB Verification; G

SD-06 Test Reports

Completed Pre-Final DALT Report; G

Certified Final DALT Report; G

TAB Design Review Report; G

TAB Report for Season 1; G

TAB Report for Season 2; G

SD-07 Certificates

Independent TAB Agency and Personnel Qualifications; G

DALT and TAB Submittal and Work Schedule; G

TAB Pre-Field Engineering Report; G

TAB Firm; G

Design Review Report; G

Pre-field DALT Preliminary Notification; G

Advanced Notice for Season 1 TAB Field Work; G

Prerequisite HVAC Work Check Out List For Season 1; G

Advanced Notice for Season 2 TAB Field Work; G

Prerequisite HVAC Work Check Out List For Season 2; G

1.6 QUALITY ASSURANCE

1.6.1 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.

1.6.2 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.

1.6.3 Qualifications

1.6.3.1 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 and the measuring of sound and vibration in environmental systems.

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.

1.6.3.2 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.

1.6.3.3 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.

1.6.3.4 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.

1.6.4 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.

1.6.4.1 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.

1.6.4.2 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.

1.6.4.3 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 two 8 hour workdays 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 workdays duration.
 - (2) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the

progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration. Review the TAB final report data and certify the TAB final report.

- k. Certified TAB report: Certify the TAB report. This certification includes the following work:
 - (1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.
 - (2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.
- l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor must submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.
- m. TAB Field Check: The TAB team supervisor must attend and supervise Season 1 and Season 2 TAB field check.

1.6.4.4 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.

1.6.5 Test Reports

1.6.5.1 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.

1.6.5.2 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) All rooms and zones. 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 1 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 profiles for all air duct systems. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to

AABC/NEBB/TABB required data:

- (1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.
- (2) Report static pressure drop across chilled water coils, DX coils, hot water coils, steam coils, electric resistance heating 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.

VAV Terminals, Fan Powered: Take readings at fan discharge and inlet static pressures for series and parallel fan powered VAV terminal boxes.

- 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.

1.7 SEQUENCING AND SCHEDULING

1.7.1 Projects with Phased Construction

This specification section is structured as though the HVAC construction, and thereby the TAB work, will be completed in a single phase. When the construction is completed in phases, the DALT work and TAB work must be planned, completed, and accepted for each construction phase.

1.7.1.1 Phasing of Work

This specification section is structured as though the HVAC construction, and thereby the TAB work, is going to be completed in a single phase in spite of the fact that there will be two seasons. All elements of the TAB work are addressed on this premise. When a contract is to be completed in construction phases, including the TAB work, and the DALT work, the TAB work and DALT work must be planned for, completed and approved by the Contracting Officer with each phase. An example of this case would be one contract that requires the rehabilitation of the HVAC in each of several separated buildings. At the completion of the final phase, compile all approved reports and submit as one document.

1.7.2 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 10 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.

1.7.2.1 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.

1.7.2.2 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.

1.7.2.3 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.

TAB and DALT for systems must not result in air moving equipment motors and VFDs being adjusted to operate above 85% of their rated speed without approval of the COTR. Motors or VFDs must not be configured to operate in overspeeding condition.

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.

Refer to design drawings for the Duct Construction and Leakage Testing Table.

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.

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section. The only water flow and air flow reporting which can be deferred until the Season 2 is that data which would be affected in terms of accuracy due to outside ambient conditions.

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, chilled water, DX and steam 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 Air Conditioning Units

Air conditioning systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

For refrigeration compressors/condensers/condensing units/evaporators, report data as required by NEBB, AABC, and TABB standard procedures, including refrigeration operational data.

3.4.3.4 Return Air Fans

Return air fan system including fan ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.4.3.5 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.4.3.6 Unit Heaters

All heating hot water unit heaters.

3.4.3.7 Cabinet Unit Heaters

All heating hot water unit heaters.

3.4.4 TAB Water Distribution Systems

3.4.4.1 Heating Hot Water

Heating hot water systems including boilers, hot water converters (e.g., heat exchangers), pumps, coils, system balancing valves and flow measuring devices.

Heating hot water system propylene glycol packaged skid unit.

3.4.4.2 Domestic Hot Water System

Domestic hot water systems including boilers, water heaters, pumps, package booster skid system, system balancing valves, and flow measuring devices.

Domestic hot water systems thermal mixing valves.

3.4.5 Sound Measurement Work

3.4.5.1 Areas To Be Sound Measured

In the following spaces, measure and record the sound power level for each octave band listed in ASHRAE HVAC APP IP HDBK Noise Criteria:

- a. All HVAC mechanical rooms, including machinery spaces and other spaces containing HVAC power drivers and power driven equipment.

- b. All spaces sharing a common barrier with each mechanical room, including rooms overhead, rooms on the other side of side walls, and rooms beneath the mechanical room floor.
- c. All spaces with STC rating classifications for security requirements.
- d. All spaces sharing a common barrier with STC rating classified spaces.

3.4.5.2 Procedure

Measure sound levels in each room, when unoccupied except for the TAB team, with all HVAC systems that would cause sound readings in the room operating in their noisiest mode. Record the sound level in each octave band. Attempt to mitigate the sound level and bring the level to within the specified ASHRAE HVAC APP IP HDBK noise criteria goals, if such mitigation is within the TAB team's control. State in the report the ASHRAE HVAC APP IP HDBK noise criteria goals. If sound level cannot be brought into compliance, provide written notice of the deficiency to the Contractor for resolution or correction.

3.4.5.3 Timing

Measure sound levels at times prescribed by AABC or NEBB or TABB.

3.4.5.4 Meters

Measure sound levels with a sound meter complying with ASA S1.4, Type 1 or 2, and an octave band filter set complying with ASA S1.11 PART 1. Use measurement methods for overall sound levels and for octave band sound levels as prescribed by NEBB.

3.4.5.5 Calibration

Calibrate sound levels as prescribed by AABC or NEBB or TABB, except that calibrators emitting a sound pressure level tone of 94 dB at 1000 hertz (Hz) are also acceptable.

3.4.5.6 Background Noise Correction

Determine background noise component of room sound (noise) levels for each (of eight) octave bands as prescribed by AABC or NEBB or TABB.

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. Visit the contract site during the season of maximum

heating load and visit the contract site during the season of maximum cooling load, the goal being to TAB the operational performance of the heating systems and cooling systems under their respective maximum outdoor environment-caused loading. During the seasonal limitations, TAB the operational performance of the heating systems and cooling systems.

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 Air Cooled Direct Expansion Units

For air cooled direct expansion compressors/condensers/condensing units /heat pumps, 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 and 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, sound level readings) recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the COTR. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: All boilers, return fans, computer room units, and outdoor air handling units outdoor, air conditioning only split systems, unit heaters and cabinet unit heaters).

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 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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS

02/13, CHG 7: 05/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
 - 1.2.1 General
- 1.3 SUBMITTALS
- 1.4 CERTIFICATIONS
 - 1.4.1 Adhesives and Sealants
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Installer Qualification
- 1.6 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

- 2.1 STANDARD PRODUCTS
 - 2.1.1 Insulation System
 - 2.1.2 Surface Burning Characteristics
- 2.2 MATERIALS
 - 2.2.1 Adhesives
 - 2.2.1.1 Mineral Fiber Insulation Cement
 - 2.2.1.2 Lagging Adhesive
 - 2.2.1.3 Contact Adhesive
 - 2.2.2 Caulking
 - 2.2.3 Corner Angles
 - 2.2.4 Fittings
 - 2.2.5 Finishing Cement
 - 2.2.6 Fibrous Glass Cloth and Glass Tape
 - 2.2.7 Staples
 - 2.2.8 Jackets
 - 2.2.8.1 Aluminum Jackets
 - 2.2.8.2 Polyvinyl Chloride (PVC) Jackets
 - 2.2.8.3 Vapor Barrier/Weatherproofing Jacket
 - 2.2.8.4 Vapor Barrier/Vapor Retarder
 - 2.2.9 Vapor Retarder Required
 - 2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)
 - 2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings
 - 2.2.9.2.1 Vapor Barrier
 - 2.2.9.2.2 Vapor Retarder
 - 2.2.9.3 Laminated Film Vapor Retarder
 - 2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder
 - 2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape
 - 2.2.9.6 Vapor Barrier/Weather Barrier
 - 2.2.10 Vapor Retarder Not Required
 - 2.2.11 Wire
 - 2.2.12 Insulation Bands
 - 2.2.13 Sealants

- 2.3 PIPE INSULATION SYSTEMS
 - 2.3.1 Recycled Materials
 - 2.3.2 Aboveground Cold Pipeline (-30 to 60 deg. F)
 - 2.3.2.1 Cellular Glass
 - 2.3.3 Aboveground Hot Pipeline (Above 60 deg. F)
 - 2.3.3.1 Cellular Glass
 - 2.3.4 Above Ground Refrigerant Piping
 - 2.3.4.1 Flexible Elastomeric Cellular Insulation
- 2.4 DUCT INSULATION SYSTEMS
 - 2.4.1 Field Applied Insulation
 - 2.4.1.1 Rigid Insulation
 - 2.4.2 Duct Insulation Jackets
 - 2.4.2.1 All-Purpose Jacket
 - 2.4.2.2 Metal Jackets
 - 2.4.2.2.1 Aluminum Jackets
 - 2.4.2.3 Vapor Barrier/Weatherproofing Jacket
 - 2.4.3 Weatherproof Duct Insulation
- 2.5 EQUIPMENT INSULATION SYSTEMS

PART 3 EXECUTION

- 3.1 APPLICATION - GENERAL
 - 3.1.1 Display Samples
 - 3.1.1.1 Pipe Insulation Display Sections
 - 3.1.1.2 Duct Insulation Display Sections
 - 3.1.2 Installation
 - 3.1.3 Firestopping
 - 3.1.4 Painting and Finishing
 - 3.1.5 Installation of Flexible Elastomeric Cellular Insulation
 - 3.1.5.1 Adhesive Application
 - 3.1.5.2 Adhesive Safety Precautions
 - 3.1.6 Welding
 - 3.1.7 Pipes/Ducts/Equipment That Require Insulation
- 3.2 PIPE INSULATION SYSTEMS INSTALLATION
 - 3.2.1 Pipe Insulation
 - 3.2.1.1 General
 - 3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors
 - 3.2.1.2.1 Penetrate Interior Walls
 - 3.2.1.2.2 Penetrating Floors
 - 3.2.1.2.3 Penetrating Waterproofed Floors
 - 3.2.1.2.4 Penetrating Exterior Walls
 - 3.2.1.2.5 Penetrating Roofs
 - 3.2.1.2.6 Hot Water Pipes Supplying Lavatories or Other Similar Heated Service
 - 3.2.1.2.7 Domestic Cold Water Pipes Supplying Lavatories or Other Similar Cooling Service
 - 3.2.1.3 Pipes Passing Through Hangers
 - 3.2.1.3.1 Horizontal Pipes Larger Than 2 Inches at 16 Degrees C 60 Degrees F and Above
 - 3.2.1.3.2 Horizontal Pipes Larger Than 2 Inches and Below 16 Degrees C 60 Degrees F
 - 3.2.1.3.3 Vertical Pipes
 - 3.2.1.3.4 Inserts
 - 3.2.1.4 Flexible Elastomeric Cellular Refrigerant Pipe Insulation
 - 3.2.1.5 Pipes in high abuse areas or exposed below ceilings..
 - 3.2.1.6 Pipe Insulation Material and Thickness
 - 3.2.2 Aboveground Cold Pipelines
 - 3.2.2.1 Insulation Material and Thickness
 - 3.2.2.2 Factory or Field applied Jacket

- 3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe
 - 3.2.2.3.1 Longitudinal Laps of the Jacket Material
 - 3.2.2.3.2 Laps and Butt Strips
 - 3.2.2.3.3 Factory Self-Sealing Lap Systems
 - 3.2.2.3.4 Staples
 - 3.2.2.3.5 Breaks and Punctures in the Jacket Material
 - 3.2.2.3.6 Penetrations Such as Thermometers
 - 3.2.2.3.7 Flexible Elastomeric Cellular Pipe Insulation
- 3.2.2.4 Insulation for Fittings and Accessories
- 3.2.2.5 Optional PVC Fitting Covers
- 3.2.3 Aboveground Hot Pipelines
 - 3.2.3.1 General Requirements
 - 3.2.3.2 Insulation for Fittings and Accessories
 - 3.2.3.2.1 Precut or Preformed
 - 3.2.3.2.2 Rigid Preformed
- 3.2.4 Piping Exposed to Weather
 - 3.2.4.1 Aluminum Jacket
 - 3.2.4.2 Insulation for Fittings
 - 3.2.4.3 PVC Jacket
 - 3.2.4.4 Stainless Steel Jackets
- 3.3 DUCT INSULATION SYSTEMS INSTALLATION
 - 3.3.1 Duct Insulation Minimum Thickness
 - 3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct
 - 3.3.2.1 Installation on Concealed Duct
 - 3.3.2.2 Installation on Exposed Duct Work
 - 3.3.3 Insulation for Warm Air Duct
 - 3.3.3.1 Installation on Concealed Duct
 - 3.3.3.2 Installation on Exposed Duct
 - 3.3.4 Ducts Handling Air for Dual Purpose
 - 3.3.5 Duct Test Holes
 - 3.3.6 Duct Exposed to Weather
 - 3.3.6.1 Installation
 - 3.3.6.2 Round Duct
 - 3.3.6.3 Fittings
 - 3.3.6.4 Rectangular Ducts
- 3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION
 - 3.4.1 General
 - 3.4.2 Insulation for Cold Equipment
 - 3.4.2.1 Insulation Type
 - 3.4.2.2 Pump Insulation
 - 3.4.2.3 Other Equipment
 - 3.4.2.4 Vapor Retarder/Vapor Barrier
 - 3.4.3 Insulation for Hot Equipment
 - 3.4.3.1 Insulation
 - 3.4.3.2 Insulation of Condensing Boiler Stack
 - 3.4.3.3 Insulation of Pumps
 - 3.4.3.4 Insulation of Other Equipment
 - 3.4.4 Equipment Handling Dual Temperature Media
 - 3.4.5 Equipment Exposed to Weather
 - 3.4.5.1 Installation

-- End of Section Table of Contents --

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 1-4 2020; Interpretation 5-8 2021; Addenda AS-CB 2022) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASHRAE 90.1 - SI (2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A167 (2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A240/A240M (2020a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASTM A580/A580M (2018) Standard Specification for Stainless Steel Wire

ASTM B209 (2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM C195 (2007; R 2013) Standard Specification for Mineral Fiber Thermal Insulating Cement

ASTM C450 (2008) Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging

ASTM C534/C534M (2020a) Standard Specification for

	Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C547	(2019) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	(2021) Standard Specification for Cellular Glass Thermal Insulation
ASTM C647	(2008; R 2013) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C755	(2019b) Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation
ASTM C795	(2008; R 2018) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C921	(2010) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C1136	(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 D5590	(2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM E2231	(2019) Standard Practice for Specimen

Preparation and Mounting of Pipe and Duct
Insulation Materials to Assess Surface
Burning Characteristics

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350 (2010; Version 1.1) Standard Method for
the Testing and Evaluation of Volatile
Organic Chemical Emissions from Indoor
Sources using Environmental Chambers

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 May 2021) 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. . Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval for information only. "AE" 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:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings

MICA Plates; G

Pipe Insulation Systems and Associated Accessories; G

Duct Insulation Systems and Associated Accessories; G

Equipment Insulation Systems and Associated Accessories; G

Recycled content for insulation materials; S

SD-03 Product Data

Pipe Insulation Systems; G

Duct Insulation Systems; G

Equipment Insulation Systems; G

SD-04 Samples

Thermal Insulation; G

Display Samples; G

SD-07 Certificates

Indoor air quality for adhesives; S

SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G

Duct Insulation Systems; G

Equipment Insulation Systems; G

1.4 CERTIFICATIONS

1.4.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification and 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.

For compliance with sustainability requirements, provide adhesives and sealants applied within the building interior with VOC emissions certified in compliance with California Department of Public Health CDPH SECTION 01350 Standard Method and VOC content in compliance with limits of SCAQMD Rule 1168.

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

In accordance with LEED V4, provide adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that

meet emissions requirements of CDPH SECTION 01350 (limit requirements for office spaces regardless of space) and VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants must meet limit requirements of "Other" category within SCAQMD Rule 1168 sealants table). Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.2.1.1 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.2 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. To resist mold/mildew, lagging adhesive shall meet ASTM D5590 with 0 growth rating. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Adhesive shall be MIL-A-3316, Class 1, pigmented white and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.1.3 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Flexible Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product listed in FM APP GUIDE.

2.2.2 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

2.2.3 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

2.2.4 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems in accordance with ASTM C1710. Together with the flexible elastomeric tubes, they provide complete system integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor). For satisfactory performance, properly installed protective vapor retarder/barriers and vapor stops shall be used on high relative humidity and below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder interior surface.

2.2.5 Finishing Cement

ASTM C450: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Staples

Outward clinching type ASTM A167, Type 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. Provide vapor barrier between jacket and piping or ductwork.

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 ; 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.

2.2.8.4 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

- a. On ducts, piping and equipment operating below 60 degrees F or located outside shall be equipped with a vapor barrier.
- b. Ducts, pipes and equipment that are located inside and that always operate above 60 degrees F shall be installed with a vapor retarder where required as stated in paragraph VAPOR RETARDER REQUIRED.

2.2.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible elastomerics require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity and below ambient temperature applications.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

ASJ is for use on hot/cold pipes, ducts, or equipment indoors or outdoors if covered by a suitable protective jacket. The product shall meet all physical property and performance requirements of ASTM C1136, Type I, except the burst strength shall be a minimum of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) shall be a minimum of 31.

In addition, neither the outer exposed surface nor the inner-most surface contacting the insulation shall be paper or other moisture-sensitive material. The outer exposed surface shall be white and have an emittance of not less than 0.80. The outer exposed surface shall be paintable.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

2.2.9.2.1 Vapor Barrier

The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Permeability shall be

less than 0.02 when tested in accordance with ASTM E96/E96M. Products shall meet UL 723 or ASTM E84 flame and smoke requirements and shall be UV resistant.

2.2.9.2.2 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be in accordance with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions. The coating shall be nonflammable, fire resistant type. To resist mold/mildew, coating shall meet ASTM D5590 with 0 growth rating. Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be determined pursuant to ASTM C647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork; where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested in accordance with ASTM D882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for Laminated Film Vapor Retarder above.

2.2.9.6 Vapor Barrier/Weather Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E96/E96M). Vapor barrier shall meet UL 723 or ASTM E84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with 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

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.

2.3.3 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 Cellular Glass

ASTM C552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.4 Above Ground Refrigerant Piping

2.3.4.1 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.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Field Applied Insulation

Provide factory-applied ASTM C547 formed mineral fiber insulation with integral wicking material (MFIWM) insulation according to manufacturer's recommendations for insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier, with identification of installed thermal resistance (R) value and out-of-package R value.

2.4.1.1 Rigid Insulation

Mineral fiber insulation must be rigid formed. Calculate the minimum thickness in accordance with ASHRAE 90.1.

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.

2.4.2.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty white or natural).

2.4.3 Weatherproof Duct Insulation

Insulate ductwork and accessories as specified in Tables 5 and 6. Provide

ASTM C547 mineral fiber insulation, rigid formed with an integral wicking material designed to remove condensed water. Provide vapor barrier as specified in manufacturer's instructions.

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

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Display Samples

Submit and display, after approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

3.1.1.1 Pipe Insulation Display Sections

Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

3.1.1.2 Duct Insulation Display Sections

Display sample sections for rigid and flexible duct insulation used on the

job. Use a temporary covering to enclose and protect display sections for duct insulation exposed to weather

3.1.2 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests and heat tracing specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.3 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING. The protection of ducts at point of passage through firewalls must be in accordance with NFPA 90A and/or NFPA 90B. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by UL, FM, or a NRTL.

3.1.4 Painting and Finishing

Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.5 Installation of Flexible Elastomeric Cellular Insulation

Install flexible elastomeric cellular insulation with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 220 degrees F. Stagger seams when applying multiple layers of insulation. Protect insulation exposed to weather and not shown to have vapor barrier weatherproof jacketing with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured.

3.1.5.1 Adhesive Application

Apply a brush coating of adhesive to both butt ends to be joined and to both slit surfaces to be sealed. Allow the adhesive to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.5.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices.

3.1.6 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.7 Pipes/Ducts/Equipment That Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items as specified.

3.2 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

Cellular glass pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Air chambers.
- e. Adjacent insulation.
- f. ASME stamps.
- g. Access plates of fan housings.
- h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

Pipe insulation shall be continuous through the sleeve.

Provide an aluminum jacket or vapor barrier/weatherproofing self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder over the insulation wherever penetrations require sealing.

3.2.1.2.1 Penetrate Interior Walls

The aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plies standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

3.2.1.2.2 Penetrating Floors

Extend the aluminum jacket from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

3.2.1.2.3 Penetrating Waterproofed Floors

Extend the aluminum jacket from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

3.2.1.2.4 Penetrating Exterior Walls

Continue the aluminum jacket required for pipe exposed to weather through the sleeve to a point 2 inches beyond the interior surface of the wall.

3.2.1.2.5 Penetrating Roofs

Insulate pipe as required for interior service to a point flush with the top of the flashing and sealed with flashing sealant. Tightly butt the insulation for exterior application to the top of flashing and interior insulation. Extend the exterior aluminum jacket 2 inches down beyond the end of the insulation to form a counter flashing. Seal the flashing and counter flashing underneath with metal jacketing/flashing sealant.

3.2.1.2.6 Hot Water Pipes Supplying Lavatories or Other Similar Heated Service

Terminate the insulation on the backside of the finished wall. Protect the insulation termination with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). Extend the coating out onto the insulation 2 inches and seal the end of the insulation. Overlap glass tape seams 1 inch. Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

3.2.1.2.7 Domestic Cold Water Pipes Supplying Lavatories or Other Similar Cooling Service

Terminate the insulation on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). Protect

the insulation with two coats of weather barrier mastic (breather emulsion type weatherproof mastic impermeable to water and permeable to air) with a minimum total thickness of 1/16 inch. Extend the mastic out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and caulk the wall penetration with an approved fire stop material having vapor retarder properties. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-58. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

3.2.1.3.1 Horizontal Pipes Larger Than 2 Inches at 60 Degrees F and Above

Supported on hangers in accordance with MSS SP-58, and Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.2.1.3.2 Horizontal Pipes Larger Than 2 Inches and Below 60 Degrees F

Supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-58. An insulation insert of cellular glass, prefabricated insulation pipe hangers, or perlite above 80 degrees F shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

3.2.1.3.3 Vertical Pipes

Supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-58 covering the 360-degree arc of the insulation. An insulation insert of cellular glass 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 Refrigerant Pipe Insulation

Flexible elastomeric cellular pipe insulation must be used only on refrigerant piping, and must 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 or exposed below ceilings..

In high abuse areas such as janitor closets equipment rooms, and for any exposed, insulated piping located less than 7 feet above floor, and mechanical rooms, welded PVC jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.1.6 Pipe Insulation Material and Thickness

Pipe insulation materials must be as listed in Table 1 and must meet or exceed the requirements of ASHRAE 90.1 - SI.

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)					
	Cellular Glass	ASTM C552	II	2	No
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)					

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
	Cellular Glass	ASTM C552	II	2	No
Refrigerant Suction Piping (35 degrees F nominal)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel					
	Cellular Glass	ASTM C552	II	2	No
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)					
	Cellular Glass	ASTM C552	III		Yes
Condensate Drain Located Inside Building					
	Cellular Glass	ASTM C552	II	2	No
Note: VR/VB = Vapor Retarder/Vapor Barrier					

TABLE 2						
Piping Insulation Thickness (inch)						
Do not use integral wicking material in Cold water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
Heating Hot Water Supply & Return (Max 250 F)						
	Cellular Glass	2	2.5	3	3	3
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)						
	Cellular Glass	1.5	1.5	1.5	2	2

TABLE 2						
Piping Insulation Thickness (inch) Do not use integral wicking material in Cold water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
Refrigerant Suction Piping (35 degrees F nominal)						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel						
	Cellular Glass	1.5	1.5	1.5	2	2
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
Condensate Drain Located Inside Building						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5

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. Horizontal and vertical portions of interior roof drains.
- c. Refrigerant suction lines.
- d. Air conditioner condensate drains.
- e. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.
- f. Domestic cold and chilled drinking water.

3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, silver, white, black and embossed for use with Mineral Fiber, and Cellular Glass. 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 all pipe insulation to the 6 ft level.

Provide separate vapor barrier wherever metal jacketing is used.

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".

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, white and embossed aluminum jacket shall be applied.

Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with metal jacketing/flashing sealant while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air)

recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant).

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.2.4.4 Stainless Steel Jackets

ASTM A167 or ASTM A240/A240M; Type 304, minimum thickness of 33 gauge (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

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 - SI.

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
Warm Air Ducts	2.0
Relief Ducts	1.5

Table 4 - Minimum Duct Insulation (inches)	
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. Plenums.
- e. Duct-mounted coil casings.
- d. Coil headers and return bends.
- e. Coil casings.
- f. Fresh air intake ducts.
- g. Filter boxes.
- h. Mixing boxes (field-insulated).
- i. Supply fans (field-insulated).
- j. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

3.3.2.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct

in 6 inch wide strips on 12 inch centers.

- b. For rectangular, round 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. 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 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

- a. Supply ducts.
- b. Return air ducts.
- c. Relief air ducts
- d. Exhaust air ducts conveying moisture laden air.
- e. Plenums.
- f. Duct-mounted coil casings.

- g. Coil-headers and return bends.
- h. Coil casings.
- i. Fresh air intake ducts.
- j. Filter boxes.
- k. Mixing boxes.
- l. Supply fans.
- m. Site-erected air conditioner casings.
- n. Ducts exposed to weather.
- o. Exhaust ducts passing through concealed spaces exhausting conditioned air.

Insulation for rectangular ducts shall be flexible type where concealed, and rigid type where exposed. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

- a. For rectangular, oval and round ducts, 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, round and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.
- 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 18 inch centers and not more than 18 inches from duct corners.
- d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.
- e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.
- f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

3.3.3.2 Installation on Exposed Duct

- a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 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 and a minimum of one row for each side of duct less than 12 inches.
- b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection 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 the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin trimmed and bent over.
- d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.
- e. Breaks and 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 adhesive and stapled.
- f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.
- g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

3.3.4 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.

3.3.5 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.6 Duct Exposed to Weather

3.3.6.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.6.2 Round Duct

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 or greater than 8 ply, heavy duty, white and natural) membrane shall be applied overlapping material by 3 inches no bands or caulking needed - see manufacturer's recommended installation instructions. Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 3 inches and secured with bands located at circumferential laps and at not more than 12 inch intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with metal jacketing sealant to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with metal jacketing sealant.

3.3.6.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.6.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws or vapor barrier/weatherproofing jacket less than 0.0000 permeability greater than 3 ply, standard grade, silver, white, black, and embossed or greater than 8 ply, heavy duty white and natural. Membrane shall be applied overlapping material by 3 inches. No bands or caulking needed-see manufacturing recommend installation instructions.

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. Pumps.
- b. Refrigeration equipment parts that are not factory insulated.
- c. Drip pans under chilled equipment.
- d. Roof drain bodies.
- e. Outdoor 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		
	Flexible Elastomeric Cellular	2
1 to 34 degrees F		
	Flexible Elastomeric Cellular	2
Minus 30 to 0 degrees F		
	Flexible Elastomeric Cellular	2.5

3.4.2.2 Pump Insulation

- a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Std's plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.
- b. Exposed insulation corners shall be protected with corner angles.

- c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Flashing sealant shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

- a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible elastomeric cellular which shall be adhered with contact adhesive. Insulation corners shall be protected under wires and bands with suitable corner angles.
- c. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.
- d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch.
- e. Exposed insulation corners shall be protected with corner angles.
- f. Insulation on equipment with ribs shall be applied over 6 by 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inches washers or shall be securely banded or wired in place on 12 inch centers.

3.4.2.4 Vapor Retarder/Vapor Barrier

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating or vapor barrier jacket shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Flashing sealant or vapor barrier tape shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

- a. Water heaters.

- b. Pumps handling media above 130 degrees F.
- c. Hot water storage tanks.
- d. Air separation tanks.
- e. Unjacketed boilers or parts of boilers.
- f. Boiler flue gas connection from boiler to stack (if inside).
- g. Induced draft fans.

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
	Calcium Silicate/Perlite	4
200psig or 400 degrees F		
	Rigid Mineral Fiber	3
	Calcium Silicate/Perlite	4
600 degrees F		
	Calcium Silicate/Perlite	6
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 Condensing Boiler Stack

Condensing boiler exhaust flue pipe must be prefabricated dual wall AL294 stainless steel construction with calcium silicate insulation between inner and outer layers.

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 Insulation of 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 gaugewelded 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. On equipment handling media above 600 degrees F, insulation shall be applied in two or more layers with joints staggered.
- h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Equipment exposed to weather shall be manufacturer's dual wall construction with sandwiched metal panel with minimum 3 PCF high density foam insulation meeting or exceeding ASHRAE 90.1 - IP requirements

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

02/19, CHG 3: 05/21

PART 1 GENERAL

1.1 SUMMARY

- 1.1.1 System Requirements
- 1.1.2 End to End Accuracy
- 1.1.3 Verification of Dimensions
- 1.1.4 Drawings

1.2 RELATED SECTIONS

1.3 REFERENCES

1.4 DEFINITIONS

- 1.4.1 Alarm Generation (All protocols)
- 1.4.2 Building Automation and Control Network (BACnet) (BACnet)
- 1.4.3 BACnet Advanced Application Controller (B-AAC) (BACnet)
- 1.4.4 BACnet Application Specific Controller (B-ASC) (BACnet)
- 1.4.5 BACnet Building Controller (B-BC) (BACnet)
- 1.4.6 BACnet Broadcast Management Device (BBMD) (BACnet)
- 1.4.7 BACnet/IP (BACnet)
- 1.4.8 BACnet Internetwork (BACnet)
- 1.4.9 BACnet Interoperability Building Blocks (BIBBs) (BACnet)
- 1.4.10 BACnet Network (BACnet)
- 1.4.11 BACnet Operator Display (B-OD) (BACnet)
- 1.4.12 BACnet Segment (BACnet)
- 1.4.13 BACnet Smart Actuator (B-SA) (BACnet)
- 1.4.14 BACnet Smart Sensor (B-SS) (BACnet)
- 1.4.15 BACnet Testing Laboratories (BTL) (BACnet)
- 1.4.16 BACnet Testing Laboratories (BTL) Listed (BACnet)
- 1.4.17 Binary (All protocols)
- 1.4.18 Broadcast (BACnet)
- 1.4.19 Building Control Network (BCN) (All protocols)
- 1.4.20 Building Point of Connection (BPOC) (All protocols)
- 1.4.21 Commandable (All protocols)
- 1.4.22 Commandable Objects (BACnet)
- 1.4.23 Configurable (All protocols)
- 1.4.24 Control Logic Diagram (All protocols)
- 1.4.25 Device (BACnet)
- 1.4.26 Device Object (BACnet)
- 1.4.27 Device Profile (BACnet)
- 1.4.28 Digital Controller (All protocols)
- 1.4.29 Direct Digital Control (DDC) (All protocols)
- 1.4.30 Field Point of Connection (FPOC) (All protocols)
- 1.4.31 Gateway (All protocols)
- 1.4.32 IEEE 802.3 Ethernet (All protocols)
- 1.4.33 Internet Protocol (IP, TCP/IP, UDP/IP) (All protocols)
- 1.4.34 Input/Output (I/O) (All protocols)
- 1.4.35 I/O Expansion Unit (All protocols)
- 1.4.36 IP subnet (All protocols)

- 1.4.37 Local-Area Network (LAN) (All protocols)
- 1.4.38 Local Display Panels (LDPs) (All protocols)
- 1.4.39 MAC Address (All protocols)
- 1.4.40 Master-Slave/Token-Passing (MS/TP) (BACnet)
- 1.4.41 Monitoring and Control (M&C) Software (All protocols)
- 1.4.42 Network Number (BACnet)
- 1.4.43 Object (BACnet)
- 1.4.44 Object Identifier (BACnet)
- 1.4.45 Object Instance (BACnet)
- 1.4.46 Object Properties (BACnet)
- 1.4.47 Operator Configurable (All protocols)
- 1.4.48 Override (All protocols)
- 1.4.49 Packaged Equipment (All protocols)
- 1.4.50 Packaged Unit (All protocols)
- 1.4.51 Performance Verification Test (PVT) (All protocols)
- 1.4.52 Physical Segment (BACnet)
- 1.4.53 Polling (All protocols)
- 1.4.54 Points (All protocols)
- 1.4.55 Proportional, Integral, and Derivative (PID) Control Loop
(All protocols)
- 1.4.56 Proprietary (BACnet)
- 1.4.57 Protocol Implementation Conformance Statement (PICS) (BACnet)
- 1.4.58 Repeater (All protocols)
- 1.4.59 Router (All protocols)
- 1.4.60 Segment (All protocols)
- 1.4.61 Standard BACnet Objects (BACnet)
- 1.4.62 Standard BACnet Properties (BACnet)
- 1.4.63 Standard BACnet Services (BACnet)
- 1.4.64 UMCS (All protocols)
- 1.4.65 UMCS Network (All protocols)
- 1.4.66 Writable Property (BACnet)
- 1.5 PROJECT SEQUENCING
- 1.6 SUBMITTALS
- 1.7 DATA PACKAGE AND SUBMITTAL REQUIREMENTS
- 1.8 SOFTWARE FOR DDC HARDWARE AND GATEWAYS
 - 1.8.1 Configuration Software
 - 1.8.2 Controller Configuration Settings
 - 1.8.3 Programming Software
 - 1.8.4 Controller Application Programs
- 1.9 QUALITY CONTROL CHECKLISTS
 - 1.9.1 Pre-Construction Quality Control (QC) Checklist
 - 1.9.2 Post-Construction Quality Control (QC) Checklist
 - 1.9.3 Closeout Quality Control (QC) Checklist

PART 2 PRODUCTS

- 2.1 GENERAL PRODUCT REQUIREMENTS
- 2.2 PRODUCT DATA
- 2.3 OPERATION ENVIRONMENT
- 2.4 WIRELESS CAPABILITY
- 2.5 ENCLOSURES
 - 2.5.1 Outdoors
 - 2.5.2 Mechanical and Electrical Rooms
 - 2.5.3 Other Locations
- 2.6 WIRE AND CABLE
 - 2.6.1 Terminal Blocks
 - 2.6.2 Control Wiring for Binary Signals
 - 2.6.3 Control Wiring for Analog Signals
 - 2.6.4 Power Wiring for Control Devices

2.6.5 Transformers

PART 3 EXECUTION

3.1 INSTALLATION

- 3.1.1 Dielectric Isolation
- 3.1.2 Penetrations in Building Exterior
- 3.1.3 Device Mounting Criteria
- 3.1.4 Labels and Tags
- 3.1.5 Surge Protection
 - 3.1.5.1 Power-Line Surge Protection
 - 3.1.5.2 Surge Protection for Transmitter and Control Wiring
- 3.1.6 Basic Cybersecurity Requirements
 - 3.1.6.1 Passwords
 - 3.1.6.2 IP Network Physical Security

3.2 DRAWINGS AND CALCULATIONS

- 3.2.1 Sample Drawings
 - 3.2.2 Drawing Index and Legend
 - 3.2.3 Thermostat and Occupancy Sensor Schedule
 - 3.2.4 Valve Schedule
 - 3.2.5 Damper Schedule
 - 3.2.6 Project Summary Equipment Schedule
 - 3.2.7 Equipment Schedule
 - 3.2.8 Occupancy Schedule
 - 3.2.9 DDC Hardware Schedule
 - 3.2.9.1 DDC Hardware Identifier
 - 3.2.9.2 HVAC System
 - 3.2.9.3 BACnet Device Information
 - 3.2.9.3.1 Device Object Identifier
 - 3.2.9.3.2 Network Number
 - 3.2.9.3.3 MAC Address
 - 3.2.9.3.4 BTL Listing
 - 3.2.9.3.5 Alarming Information
 - 3.2.9.3.6 Scheduling Information
 - 3.2.9.3.7 Trending Information
 - 3.2.10 Points Schedule
 - 3.2.10.1 Point Name
 - 3.2.10.2 Description
 - 3.2.10.3 DDC Hardware Identifier
 - 3.2.10.4 Settings
 - 3.2.10.5 Range
 - 3.2.10.6 Input or Output (I/O) Type
 - 3.2.10.7 Object and Property Information
 - 3.2.10.8 Network Data Exchange Information (Gets Data From, Sends Data To)
 - 3.2.10.9 Override Information (Object Type and Instance Number)
 - 3.2.10.10 Trend Object Information
 - 3.2.10.11 Alarm Information
 - 3.2.10.12 Configuration Information
 - 3.2.11 Riser Diagram
 - 3.2.12 Control System Schematics
 - 3.2.13 Sequences of Operation
 - 3.2.14 Controller, Motor Starter and Relay Wiring Diagram
- 3.3 CONTROLLER TUNING
 - 3.4 START-UP
 - 3.4.1 Start-Up Test
 - 3.4.1.1 Systems Check
 - 3.4.1.1.1 Step 1 - System Inspection
 - 3.4.1.1.2 Step 2 - Calibration Accuracy Check

- 3.4.1.1.3 Step 3 - Actuator Range Check
- 3.4.1.2 Weather Dependent Test
- 3.4.2 Start-Up Testing Report
- 3.5 PERFORMANCE VERIFICATION TEST (PVT)
 - 3.5.1 PVT Procedures
 - 3.5.1.1 Sensor Accuracy Checks
 - 3.5.1.2 Endurance Test
 - 3.5.1.3 PVT Equipment List
 - 3.5.2 PVT Execution
 - 3.5.3 PVT Report
- 3.6 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS
- 3.7 MAINTENANCE AND SERVICE
 - 3.7.1 Description of Work
 - 3.7.2 Personnel
 - 3.7.3 Scheduled Inspections
 - 3.7.4 Scheduled Work
 - 3.7.5 Emergency Service
 - 3.7.6 Operation
 - 3.7.7 Records and Logs
 - 3.7.8 Work Requests
 - 3.7.9 System Modifications
- 3.8 TRAINING
 - 3.8.1 Training Documentation
 - 3.8.2 Training Course Content
 - 3.8.3 Training Documentation Submittal Requirements

ATTACHMENTS:

QC Checklist for BACnet Systems

QC CHECKLIST FOR BACNET SYSTEMS

-- End of Section Table of Contents --

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, 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 indicated and shown and in accordance with Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet systems, and 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.
- b. Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
- c. Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEMS (UMCS) FRONT END AND INTEGRATION
- d. Sections 25 05 11.21 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS FIRE AND LIFE SAFETY SYSTEMS, 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM, and 25 05 11.28 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS - ELECTRONIC SECURITY SYSTEMS.
- e. Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING

1.3 REFERENCES

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

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 135

(2020; Errata 2021) BACnet-A Data
Communication Protocol for Building
Automation and Control Networks

ASHRAE FUN IP (2017) Fundamentals Handbook, I-P Edition

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Recommended Practice on
Surge Voltages in Low-Voltage AC Power
Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2020) Enclosures for Electrical Equipment
(1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 90A (2021) Standard for the Installation of
Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 5085-3 (2006; Reprint Nov 20121) Low Voltage
Transformers - Part 3: Class 2 and Class 3
Transformers

1.4 DEFINITIONS

The following list of definitions includes terms used in Sections referenced by this Section and are included here for completeness. The definitions contained in this Section may disagree with how terms are defined or used in other documents, including documents referenced by this Section. The definitions included here are the authoritative definitions for this Section and all Sections referenced by this Section.

After each term the protocol related to that term is included in parenthesis.

1.4.1 Alarm Generation (All protocols)

Alarm Generation is the monitoring of a value, comparison of the value to alarm conditions and the creation of an alarm when the conditions set for the alarm are met. Note that this does NOT include delivery of the alarm to the final destination (such as a user interface) - see paragraph ALARM ROUTING in Section 25 10 10 UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION.

1.4.2 Building Automation and Control Network (BACnet) (BACnet)

The term BACnet is used in two ways. First meaning the BACnet Protocol Standard - the communication requirements as defined by ASHRAE 135 including all annexes and addenda. The second to refer to the overall technology related to the ASHRAE 135 protocol.

1.4.3 BACnet Advanced Application Controller (B-AAC) (BACnet)

A hardware device BTL Listed as a B-AAC, which is required to support

BACnet Interoperability Building Blocks (BIBBs) for scheduling and alarming, but is not required to support as many BIBBs as a B-BC.

1.4.4 BACnet Application Specific Controller (B-ASC) (BACnet)

A hardware device BTL Listed as a B-ASC, with fewer BIBB requirements than a B-AAC. It is intended for use in a specific application.

1.4.5 BACnet Building Controller (B-BC) (BACnet)

A hardware device BTL Listed as a B-BC. A general-purpose, field-programmable device capable of carrying out a variety of building automation and control tasks including control and monitoring via direct digital control (DDC) of specific systems and data storage for trend information, time schedules, and alarm data. Like the other BTL Listed controller types (B-AAC, B-ASC etc.) a B-BC device is required to support the server ("B") side of the ReadProperty and WriteProperty services, but unlike the other controller types it is also required to support the client ("A") side of these services. Communication between controllers requires that one of them support the client side and the other support the server side, so a B-BC is often used when communication between controllers is needed.

1.4.6 BACnet Broadcast Management Device (BBMD) (BACnet)

A communications device, typically combined with a BACnet router. A BBMD forwards BACnet broadcast messages to BACnet/IP devices and other BBMDs connected to the same BACnet/IP network. Each IP subnet that is part of a BACnet/IP network must have at least one BBMD. Note there are additional restrictions when multiple BBMDs share an IP subnet.

1.4.7 BACnet/IP (BACnet)

An extension of BACnet, Annex J, defines the use of a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnets that share the same BACnet network number. See also paragraph BACNET BROADCAST MANAGEMENT DEVICE.

1.4.8 BACnet Internetwork (BACnet)

Two or more BACnet networks, connected with BACnet routers. In a BACnet Internetwork, there exists only one message path between devices.

1.4.9 BACnet Interoperability Building Blocks (BIBBs) (BACnet)

A BIBB is a collection of one or more ASHRAE 135 Services intended to define a higher level of interoperability. BIBBs are combined to build the BACnet functional requirements for a device in a specification. Some BIBBs define additional requirements (beyond requiring support for specific services) in order to achieve a level of interoperability. For example, the BIBB DS-V-A (Data Sharing-View-A), which would typically be used by a front-end, not only requires the client to support the ReadProperty Service, but also provides a list of data types (Object / Properties) which the client must be able to interpret and display for the user.

In the BIBB shorthand notation, -A is the client side and -B is the server side.

The following is a list of some BIBBs used by this or referenced Sections:	
DS-COV-A	Data Sharing-Change of Value (A side)
DS-COV-B	Data Sharing-Change of Value (B side)
NM-RC-B	Network Management-Router Configuration (B side)
DS-RP-A	Data Sharing-Read Property (A side)
DS-RP-B	Data Sharing-Read Property (B side)
DS-RPM-A	Data Sharing-Read Property Multiple (A Side)
DS-RPM-B	Data Sharing-Read Property Multiple (B Side)
DS-WP-A	Data Sharing-Write Property (A Side)
DM-TS-B	Device Management-Time Synchronization (B Side)
DM-UTC-B	Device Management-UTC Time Synchronization (B Side)
DS-WP-B	Data Sharing-Write Property (B side)
SCHED-E-B	Scheduling-External (B side)
DM-OCD-B	Device Management-Object Creation and Deletion (B side)
AE-N-I-B	Alarm and Event-Notification Internal (B Side)
AE-N-E-B	Alarm and Event-Notification External (B Side)
T-VMT-I-B	Trending-Viewing and Modifying Trends Internal (B Side)
T-VMT-E-B	Trending-Viewing and Modifying Trends External (B Side)

1.4.10 BACnet Network (BACnet)

In BACnet, a portion of the control Internetwork consisting of one or more segments connected by repeaters. Networks are separated by routers.

1.4.11 BACnet Operator Display (B-OD) (BACnet)

A basic operator interface with limited capabilities relative to a B-OWS. It is not intended to perform direct digital control. A B-OD profile could be used for LCD devices, displays affixed to BACnet devices, handheld terminals or other very simple user interfaces.

1.4.12 BACnet Segment (BACnet)

One or more physical segments interconnected by repeaters (ASHRAE 135).

1.4.13 BACnet Smart Actuator (B-SA) (BACnet)

A simple actuator device with limited resources intended for specific

applications.

1.4.14 BACnet Smart Sensor (B-SS) (BACnet)

A simple sensing device with limited resources.

1.4.15 BACnet Testing Laboratories (BTL) (BACnet)

Established by BACnet International to support compliance testing and interoperability testing activities and consists of BTL Manager and the BTL Working Group (BTL-WG). BTL also publishes Implementation Guidelines.

1.4.16 BACnet Testing Laboratories (BTL) Listed (BACnet)

A device that has been listed by BACnet Testing Laboratory. Devices may be certified to a specific device profile, in which case the listing indicates that the device supports the required capabilities for that profile, or may be listed as "other".

1.4.17 Binary (All protocols)

A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level. 'Digital' is sometimes used interchangeably with 'binary'.

1.4.18 Broadcast (BACnet)

Unlike most messages, which are intended for a specific recipient device, a broadcast message is intended for all devices on the network.

1.4.19 Building Control Network (BCN) (All protocols)

The network connecting all DDC Hardware within a building (or specific group of buildings).

1.4.20 Building Point of Connection (BPOC) (All protocols)

A FPOC for a Building Control System. (This term is being phased out of use in preference for FPOC but is still used in some specifications and criteria. When it was used, it typically referred to a piece of control hardware. The current FPOC definition typically refers instead to IT hardware.)

1.4.21 Commandable (All protocols)

See Overridable.

1.4.22 Commandable Objects (BACnet)

Commandable Objects have a Commandable Property, Priority_Array, and Relinquish_Default Property as defined in ASHRAE 135, Clause 19.2, Command Prioritization.

1.4.23 Configurable (All protocols)

A property, setting, or value is configurable if it can be changed via hardware settings on the device, via the use of engineering software or over the control network from the front end, and is retained through (after) loss of power.

In a BACnet system, a property, setting, or value is configurable if it can be changed via one or more of:

- 1) via BACnet services (including proprietary BACnet services)
- 2) via hardware settings on the device

Note this is more stringent than the ASHRAE 135 definition.

1.4.24 Control Logic Diagram (All protocols)

A graphical representation of control logic for multiple processes that make up a system.

1.4.25 Device (BACnet)

A Digital Controller that contains a BACnet Device Object and uses BACnet to communicate with other devices.

1.4.26 Device Object (BACnet)

Every BACnet device requires one Device Object, whose properties represent the network visible properties of that device. Every Device Object requires a unique Object Identifier number on the BACnet Internetwork. This number is often referred to as the device instance or device ID.

1.4.27 Device Profile (BACnet)

A collection of BIBBs determining minimum BACnet capabilities of a device, defined in ASHRAE 135. Standard device profiles include BACnet Advanced Workstations (B-AWS), BACnet Building Controllers (B-BC), BACnet Advanced Application Controllers (B-AAC), BACnet Application Specific Controllers (B-ASC), BACnet Smart Actuator (B-SA), and BACnet Smart Sensor (B-SS).

1.4.28 Digital Controller (All protocols)

An electronic controller, usually with internal programming logic and digital and analog input/output capability, which performs control functions.

1.4.29 Direct Digital Control (DDC) (All protocols)

Digital controllers performing control logic. Usually the controller directly senses physical values, makes control decisions with internal programs, and outputs control signals to directly operate switches, valves, dampers, and motor controllers.

1.4.30 Field Point of Connection (FPOC) (All protocols)

The FPOC is the point of connection between the UMCS IP Network and the field control network (either an IP network, a non-IP network, or a combination of both). The hardware at this location which provides the connection is generally an IT device such as a switch, IP router, or firewall.

In general, the term "FPOC Location" means the place where this connection occurs, and "FPOC Hardware" means the device that provides the connection. Sometimes the term "FPOC" is used to mean either and its actual meaning (i.e. location or hardware) is determined by the context in which it is used.

1.4.31 Gateway (All protocols)

A device that translates from one protocol application data format to another. Devices that change only the transport mechanism of the protocol - "translating" from TP/FT-10 to Ethernet/IP or from BACnet MS/TP to BACnet over IP for example - are not gateways as the underlying data format does not change. Gateways are also called Communications Bridges or Protocol Translators.

1.4.32 IEEE 802.3 Ethernet (All protocols)

A family of local-area-network technologies providing high-speed networking features over various media, typically Cat 5, 5e or Cat 6 twisted pair copper or fiber optic cable.

1.4.33 Internet Protocol (IP, TCP/IP, UDP/IP) (All protocols)

A communication method, the most common use is the World Wide Web. At the lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two common protocols using IP are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes connections, also known as "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

1.4.34 Input/Output (I/O) (All protocols)

Physical inputs and outputs to and from a device, although the term sometimes describes network or "virtual" inputs or outputs. See also "Points".

1.4.35 I/O Expansion Unit (All protocols)

An I/O expansion unit provides additional point capacity to a digital controller

1.4.36 IP subnet (All protocols)

A group of devices which share a defined range IP addresses. Devices on a common IP subnet can share data (including broadcasts) directly without the need for the traffic to traverse an IP router.

1.4.37 Local-Area Network (LAN) (All protocols)

A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

1.4.38 Local Display Panels (LDPs) (All protocols)

A DDC Hardware with a display and navigation buttons, and must provide display and adjustment of points as shown on the Points Schedule and as indicated.

1.4.39 MAC Address (All protocols)

Media Access Control address. The physical device address that identifies a device on a Local Area Network.

1.4.40 Master-Slave/Token-Passing (MS/TP) (BACnet)

Data link protocol as defined by the BACnet standard. Multiple speeds (data rates) are permitted by the BACnet MS/TP standard.

1.4.41 Monitoring and Control (M&C) Software (All protocols)

The UMCS 'front end' software which performs supervisory functions such as alarm handling, scheduling and data logging and provides a user interface for monitoring the system and configuring these functions.

1.4.42 Network Number (BACnet)

A site-specific number assigned to each network. This network number must be unique throughout the BACnet Internetwork.

1.4.43 Object (BACnet)

An ASHRAE 135 Object. The concept of organizing BACnet information into standard components with various associated Properties. Examples include Analog Input objects and Binary Output objects.

1.4.44 Object Identifier (BACnet)

A grouping of two Object properties: Object Type (e.g. Analog Value, Schedule, etc.) and Object Instance (in this case, a number). Object Identifiers must be unique within a device.

1.4.45 Object Instance (BACnet)

See paragraph OBJECT IDENTIFIER

1.4.46 Object Properties (BACnet)

Attributes of an object. Examples include present value and high limit properties of an analog input object. Properties are defined in ASHRAE 135; some are optional and some are required. Objects are controlled by reading from and writing to object properties.

1.4.47 Operator Configurable (All protocols)

Operator configurable values are values that can be changed from a single common front end user interface across multiple vendor systems.

For non Niagara-based BACnet systems, a property, setting, or value in a device is Operator Configurable when it is Configurable and is either:

- a. a Writable Property of a Standard BACnet Object; or
- b. a Property of a Standard BACnet Object that is Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable.

1.4.48 Override (All protocols)

Changing the value of a point outside of the normal sequence of operation where the change has priority over the sequence and where there is a mechanism for releasing the change such that the point returns to the normal value. Overrides persist until released or overridden at the same or higher priority but are not required to persist through a loss of power. Overrides are often used by operators to change values, and generally originate at a user interface (workstation or local display panel).

1.4.49 Packaged Equipment (All protocols)

Packaged equipment is a single piece of equipment provided by a manufacturer in a substantially complete and operable condition, where the controls (DDC Hardware) are factory installed, and the equipment is sold and shipped from the manufacturer as a single entity. Disassembly and reassembly of a large piece of equipment for shipping does not prevent it from being packaged equipment. Package units may require field installation of remote sensors. Packaged equipment is also called a "packaged unit".

Note industry may use the term "Packaged System" to mean a collection of equipment that is designed to work together where each piece of equipment is packaged equipment and there is a network that connects the equipment together. A "packaged system" of this type is NOT packaged equipment; it is a collection of packaged equipment, and each piece of equipment must individually meet specification requirements.

1.4.50 Packaged Unit (All protocols)

See packaged equipment.

1.4.51 Performance Verification Test (PVT) (All protocols)

The procedure for determining if the installed BAS meets design criteria prior to final acceptance. The PVT is performed after installation, testing, and balancing of mechanical systems. Typically the PVT is performed by the Contractor in the presence of the Government.

1.4.52 Physical Segment (BACnet)

A single contiguous medium to which BACnet devices are attached (ASHRAE 135).

1.4.53 Polling (All protocols)

A device periodically requesting data from another device.

1.4.54 Points (All protocols)

Physical and virtual inputs and outputs. See also paragraph INPUT/OUTPUT (I/O).

1.4.55 Proportional, Integral, and Derivative (PID) Control Loop (All protocols)

Three parameters used to control modulating equipment to maintain a setpoint. Derivative control is often not required for HVAC systems (leaving "PI" control).

1.4.56 Proprietary (BACnet)

Within the context of BACnet, any extension of or addition to object types, properties, PrivateTransfer services, or enumerations specified in ASHRAE 135. Objects with Object_Type values of 128 and above are Proprietary Objects. Properties with Property_Identifier of 512 and above are proprietary Properties.

1.4.57 Protocol Implementation Conformance Statement (PICS) (BACnet)

A document, created by the manufacturer of a device, which describes which portions of the BACnet standard may be implemented by a given device. ASHRAE 135 requires that all ASHRAE 135 devices have a PICS, and also defines a minimum set of information that must be in it. A device as installed for a specific project may not implement everything in its PICS.

1.4.58 Repeater (All protocols)

A device that connects two control network segments and retransmits all information received on one side onto the other.

1.4.59 Router (All protocols)

A device that connects two ASHRAE 135 networks and controls traffic between the two by retransmitting signals received from one side onto the other based on the signal destination. Routers are used to subdivide a BACnet internetwork and to limit network traffic.

1.4.60 Segment (All protocols)

A 'single' section of a control network that contains no repeaters or routers. There is generally a limit on the number of devices on a segment, and this limit is dependent on the topology/media and device type.

1.4.61 Standard BACnet Objects (BACnet)

Objects with Object_Type values below 128 and specifically enumerated in Clause 21 of ASHRAE 135. Objects which are not proprietary. See paragraph PROPRIETARY.

1.4.62 Standard BACnet Properties (BACnet)

Properties with Property_Identifier values below 512 and specifically enumerated in Clause 21 of ASHRAE 135. Properties which are not proprietary. See Proprietary.

1.4.63 Standard BACnet Services (BACnet)

ASHRAE 135 services other than ConfirmedPrivateTransfer or UnconfirmedPrivateTransfer. See paragraph PROPRIETARY.

1.4.64 UMCS (All protocols)

UMCS stands for Utility Monitoring and Control System. The term refers to all components by which a project site monitors, manages, and controls real-time operation of HVAC and other building systems. These components include the UMCS "front-end" and all field building control systems

connected to the front-end. The front-end consists of Monitoring and Control Software (user interface software), browser-based user interfaces and network infrastructure.

The network infrastructure (the "UMCS Network"), is an IP network connecting multiple building or facility control networks to the Monitoring and Control Software.

1.4.65 UMCS Network (All protocols)

The UMCS Network connects multiple building or facility control networks to the Monitoring and Control Software.

1.4.66 Writable Property (BACnet)

A Property is Writable when it can be changed through the use of one or more of the WriteProperty services defined in ASHRAE 135, Clause 15 regardless of the value of any other Property. Note that in the ASHRAE 135 standard, some Properties may be writable when the Out of Service Property is TRUE; for purposes of this Section, Properties that are only writable when the Out of Service Property is TRUE are not considered to be Writable.

1.5 PROJECT SEQUENCING

TABLE II: PROJECT SEQUENCING lists the sequencing of submittals as specified in paragraph SUBMITTALS (denoted by an 'S' in the 'TYPE' column) and activities as specified in PART 3 EXECUTION (denoted by an 'E' in the 'TYPE' column). TABLE II does not specify overall project milestone and completion dates.

- a. Sequencing for Submittals: The sequencing specified for submittals is the deadline by which the submittal must be initially submitted to the Government. Following submission there will be a Government review period as specified in Section 01 33 00 SUBMITTAL PROCEDURES. If the submittal is not accepted by the Government, revise the submittal and resubmit it to the Government within 14 days of notification that the submittal has been rejected. Upon resubmittal there will be an additional Government review period. If the submittal is not accepted the process repeats until the submittal is accepted by the Government.
- b. Sequencing for Activities: The sequencing specified for activities indicates the earliest the activity may begin.
- c. Abbreviations: In TABLE II the abbreviation AAO is used for 'after approval of' and 'ACO' is used for 'after completion of'.

TABLE II. PROJECT SEQUENCING			
ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
1	S	Existing Conditions Report	N/A
2	S	DDC Contractor Design Drawings	

TABLE II. PROJECT SEQUENCING			
ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
3	S	Manufacturer's Product Data	
4	S	Pre-construction QC Checklist	
5	E	Install Building Control System	AAO #1 thru #4
6	E	Start-Up and Start-Up Testing	ACO #5
7	S	Post-Construction QC Checklist	ACO #6
8	S	Programming Software Configuration Software	ACO #6
9	S	Draft As-Built Drawings	ACO #6
10	S	Start-Up Testing Report	ACO #6
11	S	PVT Procedures	14 days before schedule start of #12 and AAO #10
12	E	Execute PVT	AAO #9 and #11
13	S	PVT Report	ACO #12
14	S	Controller Application Programs Controller Configuration Settings	AAO #13

TABLE II. PROJECT SEQUENCING			
ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
15	S	Final As-Built Drawings	AAO #13
16	S	O&M Instructions	AAO #15
17	S	Training Documentation	AAO #10 and 14 days before scheduled start of #18
18	E	Training	AAO #16 and #17
19	S	Closeout QC Checklist	ACO #18

1.6 SUBMITTALS

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

SD-02 Shop Drawings

DDC Contractor Design Drawings; G, AE

Draft As-Built Drawings; G, AE

Final As-Built Drawings; G, AE

SD-03 Product Data

Programming Software; G

Controller Application Programs; G

Configuration Software; G

Controller Configuration Settings; G

Manufacturer's Product Data; G

SD-06 Test Reports

Pre-Construction Quality Control (QC) Checklist; G

Post-Construction Quality Control (QC) Checklist; G

Start-Up Testing Report; G

PVT Procedures; G

PVT Report; G

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

Training Documentation; G

SD-11 Closeout Submittals

Enclosure Keys; G

Closeout Quality Control (QC) Checklist; G

1.7 DATA PACKAGE AND SUBMITTAL REQUIREMENTS

Technical data packages consisting of technical data and computer software (meaning technical data which relates to computer software) which are specifically identified in this project and which may be defined/required in other specifications must be delivered strictly in accordance with the CONTRACT CLAUSES and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered must be identified by reference to the particular specification paragraph against which it is furnished. All submittals not specified as technical data packages are considered 'shop drawings' under the Federal Acquisition Regulation Supplement (FARS) and must contain no proprietary information and be delivered with unrestricted rights.

1.8 SOFTWARE FOR DDC HARDWARE AND GATEWAYS

Provide all software related to the programming and configuration of DDC Hardware and Gateways as indicated. License all Software to the project site. The term "controller" as used in these requirements means both DDC Hardware and Gateways.

1.8.1 Configuration Software

For each type of controller, provide the configuration tool software in accordance with Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. Submit hard copies of the software user manuals for each software with the software submittal.

Submit Configuration Software on CD-ROM as a Technical Data Package. Submit 2 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 2 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 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 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 must be permanently disabled at the device.

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 INSTALLATION

Fully install and test the control system in accordance Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS for BACnet systems, and this Section.

3.1.1 Dielectric Isolation

Provide dielectric isolation where dissimilar metals are used for connection and support. Install control system in a manner that provides clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Install control system such that it does not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.2 Penetrations in Building Exterior

Make all penetrations through and mounting holes in the building exterior watertight.

3.1.3 Device Mounting Criteria

Install devices in accordance with the manufacturer's recommendations and as indicated and shown. Provide a weathershield for all devices installed outdoors. Provide clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Provide clearance for mechanical and electrical system maintenance; do not not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.1.4 Labels and Tags

Key all labels and tags to the unique identifiers shown on the As-Built drawings. For labels exterior to protective enclosures provide engraved plastic labels mechanically attached to the enclosure or DDC Hardware. Labels inside protective enclosures may be attached using adhesive, but must not be hand written. For tags, provide plastic or metal tags

mechanically attached directly to each device or attached by a metal chain or wire.

- a. Label all Enclosures and DDC Hardware.
- b. Tag Airflow measurement arrays (AFMA) with flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient.
- c. Tag duct static pressure taps at the location of the pressure tap

3.1.5 Surge Protection

3.1.5.1 Power-Line Surge Protection

Protect equipment connected to AC circuits to withstand power-line surges in accordance with IEEE C62.41. Do not use fuses for surge protection.

3.1.5.2 Surge Protection for Transmitter and Control Wiring

Protect DDC hardware against or provided DDC hardware capable of withstanding surges induced on control and transmitter wiring installed outdoors and as shown. Protect equipment against the following two waveforms:

- a. A waveform with a 10-microsecond rise time, a 1000-microsecond decay time and a peak current of 60 amps.
- b. A waveform with an 8-microsecond rise time, a 20-microsecond decay time and a peak current of 500 amperes.

3.1.6 Basic Cybersecurity Requirements

3.1.6.1 Passwords

Refer to Section 25 05 11.23, Cybersecurity for Facility Related Control Systems - EMCS, for password requirements.

3.1.6.2 IP Network Physical Security

Install all IP Network media in conduit. Install all IP devices including but not limited to IP-enabled DDC hardware and IP Network Hardware in lockable enclosures.

3.2 DRAWINGS AND CALCULATIONS

Provide drawings in the form and arrangement indicated and shown. Use the same abbreviations, symbols, nomenclature and identifiers shown. Assign a unique identifier as shown to each control system element on a drawing. When packaging drawings, group schedules by system. When space allows, it is permissible to include multiple schedules for the same system on a single sheet. Except for drawings covering all systems, do not put information for different systems on the same sheet.

Submit hardcopy drawings on ISO A1 34 by 22 inches or A3 17 by 11 inches sheets, and electronic drawings in PDF and in AutoCAD format. In addition, submit electronic drawings in editable Excel format for all drawings that are tabular, including but not limited to the Point Schedule and Equipment Schedule.

- a. Submit DDC Contractor Design Drawings consisting of each drawing indicated with pre-construction information depicting the intended control system design and plans. Submit DDC Contractor Design Drawings as a single complete package: 6 hard copies and 2 copies on CD-ROM.
- b. Submit Draft As-Built Drawings consisting of each drawing indicated updated with as-built data for the system prior to PVT. Submit Draft As-Built Drawings as a single complete package: 6 hard copies and 2 copies on CD-ROM.
- c. Submit Final As-Built Drawings consisting of each drawing indicated updated with all final as-built data. Final As-Built Drawings as a single complete package: 6 hard copies and 2 copies on CD-ROM.

3.2.1 Sample Drawings

Sample drawings in electronic format are available at the Whole Building Design Guide page for this section:

<http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-23-09-00>

These drawings may prove useful in demonstrating expected drawing formatting and example content and are provided for illustrative purposes only. Note that these drawings do not meet the content requirements of this Section and must be completed to meet project requirements.

3.2.2 Drawing Index and Legend

Provide an HVAC Control System Drawing Index showing the name and number of the building, military site, State or other similar designation, and Country. In the Drawing Index, list all Contractor Design Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. In the Design Drawing Legend, show and describe all symbols, abbreviations and acronyms used on the Design Drawings. Provide a single Index and Legend for the entire drawing package.

3.2.3 Thermostat and Occupancy Sensor Schedule

Provide a thermostat and occupancy sensor schedule containing each thermostat's unique identifier, room identifier and control features and functions as shown. Provide a single thermostat and occupancy sensor schedule for the entire project.

3.2.4 Valve Schedule

Provide a valve schedule containing each valve's unique identifier, size, flow coefficient Kv (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure to torque data, dimensions, and access and clearance requirements data. In the valve schedule include actuator selection data supported by calculations of the force required to move and seal the valve, access and clearance requirements. Provide a single valve schedule for the entire project.

3.2.5 Damper Schedule

Provide a damper schedule containing each damper's unique identifier, type (opposed or parallel blade), nominal and actual sizes, orientation of axis and frame, direction of blade rotation, actuator size and spring ranges, operation rate, positive positioner range, location of actuators and

damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. Include the AMCA 511 maximum leakage rate at the operating static-pressure differential for each damper in the Damper Schedule. Provide a single damper schedule for the entire project.

3.2.6 Project Summary Equipment Schedule

Provide a project summary equipment schedule containing the manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a single project equipment schedule for the entire project.

3.2.7 Equipment Schedule

Provide system equipment schedules containing the unique identifier, manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a separate equipment schedule for each HVAC system.

3.2.8 Occupancy Schedule

Provide an occupancy schedule drawing containing the same fields as the occupancy schedule Contract Drawing with Contractor updated information. Provide a single occupancy schedule for the entire project.

3.2.9 DDC Hardware Schedule

Provide a single DDC Hardware Schedule for the entire project and including following information for each device.

3.2.9.1 DDC Hardware Identifier

The Unique DDC Hardware Identifier for the device.

3.2.9.2 HVAC System

The system "name" used to identify a specific system (the name used on the system schematic drawing for that system).

3.2.9.3 BACnet Device Information

3.2.9.3.1 Device Object Identifier

The Device Object Identifier: The Object_Identifier of the Device Object

3.2.9.3.2 Network Number

The Network Number for the device.

3.2.9.3.3 MAC Address

The MAC Address for the device

3.2.9.3.4 BTL Listing

The BTL Listing of the device. If the device is listed under multiple BTL Profiles, indicate the profile that matches the use and configuration of the device as installed.

3.2.9.3.5 Alarming Information

Indicate whether the device is used for alarm generation, and which types of alarm generation the device implements: intrinsic, local algorithmic, remote algorithmic.

3.2.9.3.6 Scheduling Information

Indicate whether the device is used for scheduling.

3.2.9.3.7 Trending Information

Indicate whether the device is used for trending, and indicate if the device is used to trend local values, remote values, or both.

3.2.10 Points Schedule

Provide a Points Schedule in tabular form for each HVAC system, with the indicated columns and with each row representing a hardware point, network point or configuration point in the system.

- a. When a Points Schedule was included in the Contract Drawing package, use the same fields as the Contract Drawing with updated information in addition to the indicated fields.
- b. When Point Schedules are included in the contract package, items requiring contractor verification or input have been shown in angle brackets ("<" and ">"), such as <____> for a required entry or <value> for a value requiring confirmation. Complete all items in brackets as well as any blank cells. Do not modify values which are not in brackets without approval.

Points Schedule Columns must include:

3.2.10.1 Point Name

The abbreviated name for the point using the indicated naming convention.

3.2.10.2 Description

A brief functional description of the point such as "Supply Air Temperature".

3.2.10.3 DDC Hardware Identifier

The Unique DDC Hardware Identifier shown on the DDC Hardware Schedule and used across all drawings for the DDC Hardware containing the point.

3.2.10.4 Settings

The value and units of any setpoints, configured setpoints, configuration parameters, and settings related to each point.

3.2.10.5 Range

The range of values, including units, associated with the point, including but not limited to a zone temperature setpoint adjustment range, a sensor measurement range, occupancy values for an occupancy input, or the status

of a safety.

3.2.10.6 Input or Output (I/O) Type

The type of input or output signal associated with the point. Use the following abbreviations for entries in this column:

- a. AI: The value comes from a hardware (physical) Analog Input
- b. AO: The value is output as a hardware (physical) Analog Output
- c. BI: The value comes from a hardware (physical) Binary Input
- d. BO: The value is output as a hardware (physical) Binary Output
- e. PULSE: The value comes from a hardware (physical) Pulse Accumulator Input
- f. NET-IN: The value is provided from the network (generally from another device). Use this entry only when the value is received from another device as part of scheduling or as part of a sequence of operation, not when the value is received on the network for supervisory functions such as trending, alarming, override or display at a user interface.
- g. NET-OUT: The value is provided to another controller over the network. Use this entry only when the value is transmitted to another device as part of scheduling or as part of a sequence of operation, not when the value is transmitted on the network for supervisory functions such as trending, alarming, override or display at a user interface.

3.2.10.7 Object and Property Information

The Object Type and Instance Number for the Object associated with the point. If the value of the point is not in the Present_Value Property, then also provide the Property ID for the Property containing the value of the point. Any point that is displayed at the front end or on an LDP, is trended, is used by another device on the network, or has an alarm condition must be documented here.

3.2.10.8 Network Data Exchange Information (Gets Data From, Sends Data To)

Provide the DDC Hardware Identifier of other DDC Hardware the point is shared with.

3.2.10.9 Override Information (Object Type and Instance Number)

For each point requiring an Override, indicate if the Object for the point is Commandable or, if the use of a separate Object was specifically approved by the Contracting Officer, provide the Object Type and Instance Number of the Object to be used in overriding the point.

3.2.10.10 Trend Object Information

For each point requiring a trend, indicate if the trend is Local or Remote, the trend Object type and the trend Object instance number. For remote trends provide the DDC Hardware Identifier for the device containing the trend Object in the Points Schedule notes.

3.2.10.11 Alarm Information

Indicate the Alarm Generation Type, Event Enrollment Object Instance Number, and Notification Class Object Instance Number for each point requiring an alarm. (Note that not all alarms will have Event Enrollment Objects.)

3.2.10.12 Configuration Information

Indicate the means of configuration associated with each point.

- a. For Operator Configurable Points indicate BACnet Object and Property information (Name, Type, Identifiers) containing the configurable value. Indicate whether the property is writable always, or only when Out_Of_Service is TRUE.
- b. For Configurable Points indicate the BACnet Object and Property information as for Operator Configurable points, or identification of the configurable settings from within the engineering software for the device or identification of the hardware settings on the device.

3.2.11 Riser Diagram

The Riser Diagram of the Building Control Network may be in tabular form, and must show all DDC Hardware and all Network Hardware, including network terminators. For each item, provide the unique identifier, common descriptive name, physical sequential order (previous and next device on the network), room identifier and location within room. A single riser diagram must be submitted for the entire system.

3.2.12 Control System Schematics

Provide control system schematics in the same form as the control system schematic Contract Drawing with Contractor updated information. Provide a control system schematic for each HVAC system.

3.2.13 Sequences of Operation

Provide HVAC control system sequence of operation 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

3.2.14 Controller, Motor Starter and Relay Wiring Diagram

Provide controller wiring diagrams as functional wiring diagrams which show the interconnection of conductors and cables to each controller and to the identified terminals of input and output devices, starters and package equipment. Show necessary jumpers and ground connections and the labels of all conductors. Identify sources of power required for control systems and for packaged equipment control systems back to the panel board circuit breaker number, controller enclosures, magnetic starter, or packaged equipment control circuit. Show each power supply and transformer not integral to a controller, starter, or packaged equipment. Show the connected volt-ampere load and the power supply volt-ampere rating. Provide wiring diagrams for each HVAC system.

3.3 CONTROLLER TUNING

Tune each controller in a manner consistent with that described in the ASHRAE FUN IP and in the manufacturer's instruction manual. Tuning must consist of adjustment of the proportional, integral, and where applicable, the derivative (PID) settings to provide stable closed-loop control. Each loop must be tuned while the system or plant is operating at a high gain (worst case) condition, where high gain can generally be defined as a low-flow or low-load condition. Upon final adjustment of the PID settings, in response to a change in controller setpoint, the controlled variable must settle out at the new setpoint with no more than two (2) oscillations above and below setpoint. Upon settling out at the new setpoint the controller output must be steady. With the exception of naturally slow processes such as zone temperature control, the controller must settle out at the new setpoint within five (5) minutes. Set the controller to its correct setpoint and record and submit the final PID configuration settings with the O&M Instructions and on the associated Points Schedule.

3.4 START-UP

3.4.1 Start-Up Test

Perform the following startup tests for each control system to ensure that the described control system components are installed and functioning per this specification.

Adjust, calibrate, measure, program, configure, set the time schedules, and otherwise perform all necessary actions to ensure that the systems function as indicated and shown in the sequence of operation and other contract documents.

3.4.1.1 Systems Check

An item-by-item check must be performed for each HVAC system

3.4.1.1.1 Step 1 - System Inspection

With the system in unoccupied mode and with fan hand-off-auto switches in the OFF position, verify that power and main air are available where required and that all output devices are in their failsafe and normal positions. Inspect each local display panel to verify that all displays indicate shutdown conditions.

3.4.1.1.2 Step 2 - Calibration Accuracy Check

Perform a two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter by comparing the value from the test instrument to the network value provided by the DDC Hardware. Use digital indicating test instruments, such as digital thermometers, motor-driven psychrometers, and tachometers. Use test instruments with accuracy at least twice as accurate as the specified sensor accuracy and with calibration traceable to National Institute of Standards and Technology standards. Check one the first check point in the bottom one-third of the sensor range, and the second in the top one-third of the sensor range. Verify that the sensing element-to-DDC readout accuracies at two points are within the specified product accuracy tolerances, and if not recalibrate or replace the device and repeat the calibration check.

3.4.1.1.3 Step 3 - Actuator Range Check

With the system running, apply a signal to each actuator through the DDC Hardware controller. Verify proper operation of the actuators and positioners for all actuated devices and record the signal levels for the extreme positions of each device. Vary the signal over its full range, and verify that the actuators travel from zero stroke to full stroke within the signal range. Where applicable, verify that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other. For valve actuators and damper actuators, perform the actuator range check under normal system pressures.

3.4.1.2 Weather Dependent Test

Perform weather dependent test procedures in the appropriate climatic season.

3.4.2 Start-Up Testing Report

Submit 4 copies of the Start-Up Testing Report. The report may be submitted as a Technical Data Package documenting the results of the tests performed and certifying that the system is installed and functioning per this specification, and is ready for the Performance Verification Test (PVT).

3.5 PERFORMANCE VERIFICATION TEST (PVT)

3.5.1 PVT Procedures

Prepare PVT Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system performs in accordance with the sequences of operation, and other contract documents. Submit 4 copies of the PVT Procedures. The PVT Procedures may be submitted as a Technical Data Package.

3.5.1.1 Sensor Accuracy Checks

Include a one-point accuracy check of each sensor in the PVT procedures.

3.5.1.2 Endurance Test

Include a one-week endurance test as part of the PVT during which the system is operated continuously.

Use the building control system BACnet Trend Log or Trend Log Multiple Objects to trend all points shown as requiring a trend on the Point Schedule for the entire endurance test. If insufficient buffer capacity exists to trend the entire endurance test, upload trend logs during the course of the endurance test to ensure that no trend data is lost.

3.5.1.3 PVT Equipment List

Include in the PVT procedures a control system performance verification test equipment list that lists the equipment to be used during performance verification testing. For each piece of equipment, include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration

3.5.2 PVT Execution

Demonstrate compliance of the control system with the contract documents. Using test plans and procedures approved by the Government, software capable of reading and writing COV Notification Subscriptions, Notification Class Recipient List Properties, event enrollments, demonstrate all physical and functional requirements of the project. Show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. Do not start the performance verification test until after receipt of written permission by the Government, based on Government approval of the PVT Plan and Draft As-Built and completion of balancing. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. Do not conduct tests during scheduled seasonal off periods of base heating and cooling systems. If the system experiences any failures during the endurance test portion of the PVT, repair the system repeat the endurance test portion of the PVT until the system operates continuously and without failure for the specified endurance test period.

3.5.3 PVT Report

Prepare and submit a PVT report documenting all tests performed during the PVT and their results. Include all tests in the PVT procedures and any additional tests performed during PVT. Document test failures and repairs conducted with the test results.

Submit four copies of the PVT Report. The PVT Report may be submitted as a Technical Data Package.

3.6 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Provide HVAC control System Operation and Maintenance Instructions which include:

- a. "Data Package 3" as indicated in Section 01 78 23 OPERATION AND MAINTENANCE DATA for each piece of control equipment.
- b. "Data Package 4" as described in Section 01 78 23 OPERATION AND MAINTENANCE DATA for all air compressors.
- c. HVAC control system sequences of operation formatted as indicated.
- d. Procedures for the HVAC system start-up, operation and shut-down including the manufacturer's supplied procedures for each piece of equipment, and procedures for the overall HVAC system.
- e. As-built HVAC control system detail drawings formatted as indicated.
- f. Routine maintenance checklist. Provide the routine maintenance checklist arranged in a columnar format, where the first column lists all installed devices, the second column states the maintenance activity or that no maintenance required, the third column states the frequency of the maintenance activity, and the fourth column is used for additional comments or reference.
- g. Qualified service organization list, including at a minimum company name, contact name and phone number.

- h. Start-Up Testing Report.
- i. Performance Verification Test (PVT) Procedures and Report.

Submit 2 copies of the Operation and Maintenance Instructions, indexed and in booklet form. The Operation and Maintenance Instructions may be submitted as a Technical Data Package.

3.7 MAINTENANCE AND SERVICE

Provide services, materials and equipment as necessary to maintain the entire system in an operational state as indicated for a period of one year from the date of final acceptance of the project. Minimize impacts on facility operations.

- a. The integration of the system specified in this section into a Utility Monitoring and Control System must not, of itself, void the warranty or otherwise alter the requirement for the one year maintenance and service period. Integration into a UMCS includes but is not limited to establishing communication between devices in the control system and the front end or devices in another system.
- b. The changing of configuration properties must not, of itself, void the warranty or otherwise alter the requirement for the one year maintenance and service period.

3.7.1 Description of Work

Provide adjustment and repair of the system including the manufacturer's required sensor and actuator (including transducer) calibration, span and range adjustment.

3.7.2 Personnel

Use only service personnel qualified to accomplish work promptly and satisfactorily. Advise the Government in writing of the name of the designated service representative, and of any changes in personnel.

3.7.3 Scheduled Inspections

Perform two inspections at six-month intervals and provide work required. Coordinate inspection schedule with the Government. During each inspection perform the indicated tasks:

- a. Perform visual checks and operational tests of equipment.
- b. Clean control system equipment including interior and exterior surfaces.
- c. Check and calibrate each field device. Check and calibrate 50 percent of the total analog inputs and outputs during the first inspection. Check and calibrate the remaining 50 percent of the analog inputs and outputs during the second major inspection. Certify analog test instrumentation accuracy to be twice the specified accuracy of the device being calibrated. Randomly check at least 25 percent of all binary inputs and outputs for proper operation during the first inspection. Randomly check at least 25 percent of the remaining binary inputs and outputs during the second inspection. If more than 20 percent of checked inputs or outputs failed the calibration check

during any inspection, check and recalibrate all inputs and outputs during that inspection.

- d. Run system software diagnostics and correct diagnosed problems.
- e. Resolve any previous outstanding problems.

3.7.4 Scheduled Work

This work must be performed during regular working hours, Monday through Friday, excluding Federal holidays.

3.7.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel must be available to provide service to the system. A telephone number where the service supervisor can be reached at all times must be provided. Service personnel must be at the site within 24 hours after receiving a request for service. The control system must be restored to proper operating condition.

3.7.6 Operation

After performing scheduled adjustments and repairs, verify control system operation as demonstrated by the applicable tests of the performance verification test.

3.7.7 Records and Logs

Keep dated records and logs of each task, with cumulative records for each major component, and for the complete system chronologically. Maintain a continuous log for all devices, including initial analog span and zero calibration values and digital points. Keep complete logs and provide logs for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

3.7.8 Work Requests

Record each service call request as received and include its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. Submit a record of the work performed within 5 days after work is accomplished.

3.7.9 System Modifications

Submit recommendations for system modification in writing. Do not make system modifications, including operating parameters and control settings, without prior approval of the Government.

3.8 TRAINING

Conduct a training course for 6 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 Controls/HVAC shop supervisor.
- b. Training Manuals: Provide training manuals which include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. When presenting portions of the course material by audiovisuals, deliver copies of those audiovisuals as a part of the printed training manuals.

3.8.2 Training Course Content

For guidance in planning the required instruction, assume that attendees will have a high school education, and are familiar with HVAC systems. During the training course, cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each controller enclosure, the layout of one of each type of equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. Present the results of the performance verification test and the Start-Up Testing Report as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

3.8.3 Training Documentation Submittal Requirements

Submit hardcopy training manuals and all training materials on CD-ROM. Provide one hardcopy manual for each trainee on the Course Attendee List and 2 additional copies for archive at the project site. Provide 2 copies of the Course Attendee List with the archival copies. Training Documentation may be submitted as a Technical Data Package.

APPENDIX A

<u>QC CHECKLIST FOR BACNET SYSTEMS</u>		
<p>This checklist is not all-inclusive of the requirements of this specification and should not be interpreted as such.</p> <p>Instructions: Initial each item in the space provided (____) verifying that the requirement has been met.</p>		
<p>This checklist is for (circle one:)</p> <p>Pre-Construction QC Checklist Submittal</p> <p>Post-Construction QC Checklist Submittal</p> <p>Close-out QC Checklist Submittal</p>		
Items verified for Pre-Construction, Post-Construction and Closeout QC Checklist Submittals:		
1	All DDC Hardware is numbered on Control System Schematic Drawings.	____
2	Signal lines on Control System Schematic are labeled with the signal type.	____
3	Local Display Panel (LDP) Locations are shown on Control System Schematic drawings.	____
Items verified for Post-Construction and Closeout QC Checklist Submittals:		
4	All sequences are performed as specified using DDC Hardware.	____
5	Training schedule and course attendee list has been developed and coordinated with shops and submitted.	____
Items verified for Closeout QC Checklist Submittal:		
6	Final As-built Drawings, including all Points Schedule drawings, accurately represent the final installed system.	____
7	Programming software has been submitted for all programmable controllers.	____
8	All software has been licensed to the Government.	

<u>QC CHECKLIST FOR BACNET SYSTEMS</u>		
9	O&M Instructions have been completed and submitted.	____
10	Training course has been completed.	____
11	All DDC Hardware is installed on a BACnet ASHRAE 135 network using either MS/TP in accordance with Clause 9 or IP in accordance with Annex J.	____
12	All DDC Hardware is BTL listed.	____
13	Communication between DDC Hardware is only via BACnet using standard services, except as specifically permitted by the specification. Non-standard services have been fully documented in the DDC Hardware Schedule.	____
14	Scheduling, Alarming, and Trending have been implemented using the standard BACnet Objects for these functions.	____
15	All Properties indicated as required to be Writable are Writable and Overrides have been provided as indicated	____
<hr/>		
	(QC Representative Signature)	(Date)

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

11/15, CHG 2: 05/21

PART 1 GENERAL

- 1.1 SUMMARY
 - 1.1.1 Verification of Dimensions
 - 1.1.2 Drawings
- 1.2 RELATED SECTIONS
- 1.3 REFERENCES
- 1.4 SUBMITTALS
- 1.5 DELIVERY AND STORAGE
- 1.6 INPUT MEASUREMENT ACCURACY
- 1.7 SUBCONTRACTOR SPECIAL REQUIREMENTS

PART 2 PRODUCTS

- 2.1 EQUIPMENT
 - 2.1.1 General Requirements
 - 2.1.2 Operation Environment Requirements
 - 2.1.2.1 Pressure
 - 2.1.2.2 Vibration
 - 2.1.2.3 Temperature
 - 2.1.2.4 Humidity
- 2.2 WEATHERSHIELDS
- 2.3 WIRE AND CABLE
 - 2.3.1 Terminal Blocks
 - 2.3.2 Control Wiring for Binary Signals
 - 2.3.3 Control Wiring for Analog Signals
 - 2.3.4 Power Wiring for Control Devices
 - 2.3.5 Transformers
- 2.4 AUTOMATIC CONTROL VALVES
 - 2.4.1 Valve Type
 - 2.4.1.1 Liquid Service 150 Degrees F or Less
 - 2.4.1.2 Liquid Service Above 150 Degrees F
 - 2.4.2 Valve Flow Coefficient and Flow Characteristic
 - 2.4.2.1 Two-Way Modulating Valves
 - 2.4.3 Two-Position Valves
 - 2.4.4 Globe Valves
 - 2.4.5 Ball Valves
 - 2.4.6 Butterfly Valves
- 2.5 DAMPERS
 - 2.5.1 Damper Assembly
 - 2.5.2 Operating Linkages
 - 2.5.3 Damper Types
 - 2.5.3.1 Flow Control Dampers
- 2.6 SENSORS AND INSTRUMENTATION
 - 2.6.1 Analog and Binary Transmitters
 - 2.6.2 Network Transmitters

- 2.6.3 Temperature Sensors
 - 2.6.3.1 Sensor Accuracy and Stability of Control
 - 2.6.3.1.1 Conditioned Space Temperature
 - 2.6.3.1.2 Unconditioned Space Temperature
 - 2.6.3.1.3 Duct Temperature
 - 2.6.3.1.4 Outside Air Temperature
 - 2.6.3.1.5 Heating Hot Water
 - 2.6.3.2 Transmitter Drift
 - 2.6.3.3 Point Temperature Sensors
 - 2.6.3.4 Temperature Sensor Details
 - 2.6.3.4.1 Room Type
 - 2.6.3.4.2 Duct Probe Type
 - 2.6.3.4.3 Duct Averaging Type
 - 2.6.3.4.4 Pipe Immersion Type
 - 2.6.3.4.5 Outside Air Type
- 2.6.4 Relative Humidity Sensor
- 2.6.5 Carbon Dioxide (CO2) Sensors
- 2.6.6 Differential Pressure Instrumentation
 - 2.6.6.1 Differential Pressure Sensors
 - 2.6.6.2 Differential Pressure Switch
- 2.6.7 Flow Sensors
 - 2.6.7.1 Airflow Measurement
 - 2.6.7.2 Water Flow Measurement
 - 2.6.7.3 Flow Switch
- 2.6.8 Electrical Instruments
 - 2.6.8.1 Current Transducers
 - 2.6.8.2 Current Sensing Relays (CSRs)
- 2.6.9 Carbon Monoxide Analyzer
- 2.6.10 Vibration Switch
- 2.6.11 Temperature Switch
 - 2.6.11.1 Duct Mount Temperature Low Limit Safety Switch (Freezestat)
 - 2.6.11.2 Pipe Mount Temperature Limit Switch (Aquastat)
- 2.6.12 Damper End Switches
- 2.7 OUTPUT DEVICES
 - 2.7.1 Actuators
 - 2.7.1.1 Valve Actuators
 - 2.7.1.2 Damper Actuators
 - 2.7.1.3 Electric Actuators
 - 2.7.2 Relays
- 2.8 USER INPUT DEVICES
- 2.9 MULTIFUNCTION DEVICES
 - 2.9.1 Current Sensing Relay Command Switch

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 General Installation Requirements
 - 3.1.1.1 Device Mounting Criteria
 - 3.1.1.2 Labels and Tags
 - 3.1.2 Weathershield
 - 3.1.3 Room Instrument Mounting
 - 3.1.4 Indication Devices Installed in Piping and Liquid Systems
 - 3.1.5 Switches
 - 3.1.5.1 Temperature Limit Switch
 - 3.1.5.2 Hand-Off Auto Switches
 - 3.1.6 Temperature Sensors
 - 3.1.6.1 Room Temperature Sensors
 - 3.1.6.2 Duct Temperature Sensors

- 3.1.6.2.1 Probe Type
- 3.1.6.2.2 Averaging Type
- 3.1.6.3 Immersion Temperature Sensors
- 3.1.6.4 Outside Air Temperature Sensors
- 3.1.7 Air Flow Measurement Arrays (AFMA)
- 3.1.8 Duct Static Pressure Sensors
- 3.1.9 Relative Humidity Sensors
- 3.1.10 Meters
 - 3.1.10.1 Flowmeters
- 3.1.11 Dampers
 - 3.1.11.1 Damper Actuators
 - 3.1.11.2 Damper Installation
- 3.1.12 Valves
 - 3.1.12.1 Valve Actuators
- 3.1.13 Thermometers and Gauges
 - 3.1.13.1 Thermometers
- 3.1.14 Wire and Cable

-- End of Section Table of Contents --

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 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS

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 FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 90A (2021) Standard for the Installation of
Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 5085-3 (2006; Reprint Nov 2012) Low Voltage
Transformers - Part 3: Class 2 and Class 3
Transformers

1.4 SUBMITTALS

Submittal requirements are specified in Section 23 09 00 INSTRUMENTATION
AND CONTROL FOR HVAC.

1.5 DELIVERY AND STORAGE

Store and protect products from the weather, humidity, and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

1.6 INPUT MEASUREMENT ACCURACY

Select, install and configure sensors, transmitters and DDC Hardware such that the maximum error of the measured value at the input of the DDC hardware is less than the maximum allowable error specified for the sensor or instrumentation.

1.7 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled CONTRACTOR SPECIAL REQUIREMENTS in Section 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 General Requirements

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

2.1.2 Operation Environment Requirements

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

2.1.2.1 Pressure

Pressure conditions normally encountered in the installed location.

2.1.2.2 Vibration

Vibration conditions normally encountered in the installed location.

2.1.2.3 Temperature

- a. Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.
- b. Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of -35 to +151 degrees F and temperature conditions outside this range normally encountered at the installed location.

2.1.2.4 Humidity

10 to 95 percent relative humidity, non-condensing and also humidity conditions outside this range normally encountered at the installed

location.

2.2 WEATHERSHIELDS

Provide weathershields constructed of galvanized steel painted white, unpainted aluminum, aluminum painted white, or white PVC.

2.3 WIRE AND CABLE

Provide wire and cable meeting the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification and referenced specifications.

2.3.1 Terminal Blocks

For terminal blocks which are not integral to other equipment, provide terminal blocks which are insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for DIN rail mounting, and which have enclosed sides or end plates and partition plates for separation.

2.3.2 Control Wiring for Binary Signals

For Control Wiring for Binary Signals, provide 18 AWG copper or thicker wire rated for 300-volt service.

2.3.3 Control Wiring for Analog Signals

For Control Wiring for Analog Signals, provide 18 AWG or thicker, copper, single- or multiple-twisted wire meeting the following requirements:

- a. minimum 2 inch lay of twist
- b. 100 percent shielded pairs
- c. at least 300-volt insulation
- d. each pair has a 20 AWG tinned-copper drain wire and individual overall pair insulation
- e. cables have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.3.4 Power Wiring for Control Devices

For 24-volt circuits, provide insulated copper 18 AWG or thicker wire rated for 300 VAC service. For 120-volt circuits, provide 14 AWG or thicker stranded copper wire rated for 600-volt service.

2.3.5 Transformers

Provide UL 5085-3 approved transformers. Select transformers sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

2.4 AUTOMATIC CONTROL VALVES

Provide valves with stainless-steel stems and stuffing boxes with extended

necks to clear the piping insulation. Provide valves with bodies meeting ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure. Unless otherwise specified or indicated, provide valves meeting FCI 70-2 Class 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.

2.4.1.2 Liquid Service Above 150 Degrees F

- a. Two-position valves: Use either globe valves or ball valves except that butterfly valves may be used for sizes 4 inch and larger.
- b. Modulating valves: Use globe valves except that butterfly valves may be used for sizes 4 inch and larger.

2.4.2 Valve Flow Coefficient and Flow Characteristic

2.4.2.1 Two-Way Modulating Valves

Provide the valve coefficient (Cv) indicated. Provide equal-percentage flow characteristic for liquid service except for butterfly valves. Provide linear flow characteristic for steam service except for butterfly valves.

2.4.3 Two-Position Valves

Use full line size full port valves with maximum available (Cv).

2.4.4 Globe Valves

Over 3 Inches: Iron body, bronze trim, 316 stainless steel rising stem, bronze plug-type disc, flanged ends, renewable bronze seat and disc, TFE V-ring packing.

- a. Pressure Rating: Service of 125 psi WSP at 250°F, ANSI Class 125.
- b. Internal Construction: Replaceable plugs and seats of stainless steel or bronze.
 - (1) Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on top and bottom of guided plugs.
- c. Rangeability: 50:1
- d. Sizing: 5-psi maximum pressure drop at design flow rate.
- e. Flow Characteristics: 2-way valves shall have equal percentage characteristics; 3-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.

2.4.5 Ball Valves

Up to and including 3 Inches: Nickel-plated forged brass body, valve trim shall utilize stainless steel ball and stem, fiberglass reinforced Teflon PTFE seats with O-rings, 2 EPDM O-rings packing

- a. Flow Characterizing Disc: A flow characterizing disc, made of Tefzel Teflon shall be installed in the inlet of 2-way characterized control ball valves. 3-way valves shall utilize flow characterizing discs at both input ports. Standard ball valves without this feature are not acceptable.
- b. Pressure Rating: Service of 400 psi at 212°F.
- c. Close Off Pressure: 200 psi
- d. Rangeability: 500:1
- e. Sizing: 5-psi maximum pressure drop at design flow rate.
- f. Flow Characteristics: 2-way valves shall have equal port percentage characteristics; 3-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.

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. For modulating or throttling operation, provide high performance butterfly valves.

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 galvanized steel channels with mitered and welded corners. Steel channel frames constructed of 0.06 inch minimum thickness are acceptable provided the corners are reinforced.

- a. Flat blades must be made rigid by folding the edges. Blade-operating linkages must be within the frame so that blade-connecting devices within the same damper section must not be located directly in the air stream.
- b. Damper axles must be 1/2 inch minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically must be supported by thrust bearings.

- c. Provide dampers which do not exceed a pressure drop through the damper of 0.04 inches water gauge at 1000 ft/min in the wide-open position. Provide dampers with frames not less than 2 inch in width. Provide dampers which have been tested in accordance with AMCA 500-D.

2.5.2 Operating Linkages

For operating links external to dampers, such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, provide links able to withstand a load equal to at least 300 percent of the maximum required damper-operating force without deforming. Rod lengths must be adjustable. Links must be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises must be brass, bronze, or stainless steel. Adjustments of crank arms must control the open and closed positions of dampers.

2.5.3 Damper Types

2.5.3.1 Flow Control Dampers

Provide parallel-blade or opposed blade type dampers for outside air, return air, relief air, exhaust, face and bypass dampers as indicated on the Damper Schedule. Blades must have interlocking edges. The channel frames of the dampers must be provided with jamb seals to minimize air leakage. Unless otherwise indicated, dampers must meet AMCA 511 Class 1A requirements. For outdoor air application, dampers must be constructed with extruded aluminum blade and frame and 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.

Provide mechanically attached, field replaceable resilient seals. Attachment by adhesive is not acceptable. Provide flexible metal compression-type jamb seals constructed of corrosion-resistant steel.

Provide frames that have corner reinforcement and stay rods, where necessary. Provide frames that are fabricated by welding or riveting. Repair damaged galvanized surfaces by coating with an equal weight of zinc.

Where linkage is such that operator torque is applied to a master blade and transmitted from, provide a master blade that is reinforced and a shaft that is full length. This type construction is limited to 2 inch wg, static pressure.

Provide blades that are attached to round shafts by hardened cup-point setscrews, or by being pinned. Provide a minimum three-thread engagement. Where setscrews are used, provide two setscrews, 90 degrees apart, to secure master blade. Secure shaft end retainers by pins or spring washers in grooved shaft or by similar construction.

Caulk frames with elastomer compounds to prevent bypass leakage.

Provide maximum leakage of dampers of 3 CFM/Sq.Ft. @ 1 inch wg.

Where insulated damper is indicated, dampers shall have the blades insulated with polyurethane foam and thermally broken.

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 where required by application. The sensor shall be capable of surviving below freezing temperatures and direct contact with moisture without affecting sensor calibration, and shall be provided with any required accessories.

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

Provide high performance, thermal dispersion type air flow measuring station (AFMS). Pitot tubes, arrays, Piezo rings and other differential pressure based devices are not acceptable. AFMS shall contain an airflow straightener if required by the AFMS manufacturer's published installation instructions.

- a. Resistance to airflow. The resistance to air flow through the AFMS, including the airflow straightener shall not exceed 0.08 inch water gauge at an airflow of 2,000 fpm. AFMS construction shall be suitable for operation at airflows of up to 5,000 fpm.

b. Outside air temperature. In outside air measurement or in low-temperature air delivery applications, the AFMS shall be certified by the manufacturer to be accurate as specified over a temperature range of -20 +120 degrees F.

c. Sensing probe shall be constructed of extruded aluminum or of stainless steel tubes. The operating humidity range shall be 0 to 99% RH and direct exposure to water shall not damage the sensing elements. The sensing elements shall be distributed across the duct cross section in the quantity and pattern specified by the published application data of the AFMS manufacturer.

(1) AFMSs shall have an accuracy of +/- 2% of reading with air velocity range of 0 to 5,000 fpm.

d. The transmitter shall have local LCD display, continuously displaying airflow and temperature and be calibrated for the appropriate operating range based on the required operating range. The output signal shall be transmitted in an analog 4-20 mA, 0-10 VDC or 0-5 VDC format. The transmitter shall have a local span and zero with field configurable low and high limits and operating temperature range of -20 +120 degrees F.

2.6.7.2 Water Flow Measurement

a. Electromagnetic Flow Meter - Inline Type: Provide electromagnetic type flow meters as shown on the mechanical sheets and described hereinafter. The flow meter shall have the DC powered electromagnetic coils and electrodes, and measure the induced voltage across the electrodes as a conductive fluid flows through the magnetic fields. The voltage is proportional to the average flow velocity of the fluid and then amplified and processed digitally by the converter to produce the signal for flow rate and totalization. Provide flow meters and transducers located in the pipe as shown on the drawings. Locate meter to provide the most efficient reading point.

- (1) Flow Range: 0.1 ~ 39.4 feet/seconds
- (2) Pipe size range: 4" through 8" nominal
- (3) Flow Direction: Unidirectional or Bidirectional
- (4) Provide remote transmitter with mounted hardware and the necessary cable
- (5) Alphanumeric LCD displays total flow, flow rate, flow direction and alarm conditions
- (6) Output signal: 4-20 mA or 0-10V analog output for flow rate
- (7) Accuracy: 0.4% of calibrated span for liquids
- (8) Fluid conductivity: 5 μ S/cm minimum
- (9) Maximum fluid temperature: 140 deg F
- (10) Ambient temperature range: -4 to 140 deg F
- (11) Maximum operating pressure: 400PSI
- (12) Stainless steel electrode and tube with PTFE liner
- (13) Housing: NEMA 4X
- (14) Body: Wafer to match piping style or ANSI flanged specification
- (15) Power Supply Options: 90 to 265 VAC, 45 to 60 Hz, and 35 mA maximum

b. Electromagnetic Flow Meter - Hot-Tap Insertion Type: Provide electromagnetic type flow meters as shown on the mechanical sheets and described hereinafter. The flow meter shall have the DC powered

electromagnetic coils and electrodes, and measure the induced voltage across the electrodes as a conductive fluid flows through the magnetic fields. The voltage is proportional to the average flow velocity of the fluid and then amplified and processed digitally by the converter to produce the signal for flow rate and totalization. Provide flow meters and transducers located in the pipe as shown on the drawings. Locate meter to provide the most efficient reading point. The flow measuring sensors shall be of the hot tap insertion type. The flow meter shall be provided with all necessary accessories including, but not limited to, mounting adapter, sitting, hot tap mount/tools with ball-type isolation valve, and flow transmitter.

- (1) Flow Range: 0.1 ~ 20 feet/seconds
- (2) Pipe size range: 4" through 12" nominal
- (3) Flow Direction: Unidirectional or Bidirectional
- (4) Provide remote transmitter with mounted hardware and the necessary cable
- (5) Alphanumeric LCD displays total flow, flow rate, flow direction and alarm conditions
- (6) Output signal: 4-20 mA or 0-10V analog output for flow rate
- (7) Accuracy: 1% of calibrated span for liquids
- (8) Fluid conductivity: 20 μ S/cm minimum
- (9) Maximum fluid temperature: 140 deg F
- (10) Ambient temperature range: -4 to 140 deg F
- (11) Maximum operating pressure: 400PSI
- (12) All wetted metal parts shall be constructed of 316 stainless steel
- (13) Pressure Drop: 0.1 psi @ 12 feet/seconds
- (14) Power Supply Options: 20 to 28 VAC, 60 Hz
- (15) Provide hot tap with ball valve assembly to allow for meter removal

2.6.7.3 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.

2.6.8 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 1 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.

2.6.9 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 than 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.

2.6.10 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.

2.6.11 Temperature Switch

2.6.11.1 Duct Mount Temperature Low Limit Safety Switch (Freezestat)

Duct mount temperature low limit switches (Freezestats) must be manual reset, low temperature safety switches at least 1 foot long per square foot of coverage which must respond to the coldest 18 inch segment with an accuracy of plus or minus 3.6 degrees F. The switch must have a field-adjustable setpoint with a range of at least 30 to 50 degrees F. The switch must have two sets of contacts, and each contact must have a rating greater than its connected load. Contacts must open or close upon drop of temperature below setpoint as indicated and must remain in this state until reset.

2.6.11.2 Pipe Mount Temperature Limit Switch (Aquistat)

Pipe mount temperature limit switches (aquastats) must have a field adjustable setpoint between 60 and 90 degrees F, an accuracy of plus or

minus 3.6 degrees F and a 10 degrees F fixed deadband. The switch must have two sets of contacts, and each contact must have a rating greater than its connected load. Contacts must open or close upon change of temperature above or below setpoint as indicated.

2.6.12 Damper End Switches

Each end switch must be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure must be suitable for mounting on the duct exterior and must permit setting the position of the trip lever that actuates the switch. The trip lever must be aligned with the damper blade.

End switches integral to an electric damper actuator are allowed as long as at least one is adjustable over the travel of the actuator.

2.7 OUTPUT DEVICES

2.7.1 Actuators

Actuators must be electric (electronic). All actuators must be normally open (NO), normally closed (NC) or fail-in-last-position (FILP) as indicated. Normally open and normally closed actuators must be of mechanical spring return type. Electric actuators must have an electronic cut off or other means to provide burnout protection if stalled. Actuators must have a visible position indicator. 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 USER INPUT DEVICES

User Input Devices, including potentiometers, switches and momentary contact push-buttons. Potentiometers must be of the thumb wheel or sliding bar type. Momentary Contact Push-Buttons may include an adjustable timer for their output. User input devices must be labeled for their function.

2.9 MULTIFUNCTION DEVICES

Multifunction devices are products which combine the functions of multiple sensor, user input or output devices into a single product. Unless otherwise specified, the multifunction device must meet all requirements of each component device. Where the requirements for the component devices conflict, the multifunction device must meet the most stringent of the requirements.

2.9.1 Current Sensing Relay Command Switch

The Current Sensing Relay portion must meet all requirements of the Current Sensing Relay input device. The Command Switch portion must meet all requirements of the Relay output device except that it must have at least one normally-open (NO) contact.

Current Sensing Relays used for Variable Frequency Drives must be rated

for Variable Frequency applications unless installed on the source side of the drive. If used in this situation, the threshold for showing status must be set to allow for the VFD's control power when the drive is not enabled and provide indication of operation when the drive is enabled at minimum speed.

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 on the Room Sensor Schedule:

- a. Space Sensor Modules for Fan Coil Units may be either unit or wall mounted but not mounted on an exterior wall.
- b. Wall mount all other Space Sensor Modules.

3.1.4 Indication Devices Installed in Piping and Liquid Systems

Provide snubbers for gauges in piping systems subject to pulsation. For gauges for steam service use pigtail fittings with cock. Install thermometers and temperature sensing elements in liquid systems in thermowells. Provide spare Pressure/Temperature Ports (Pete's Plug) for all temperature and pressure sensing elements installed in liquid systems for calibration/testing.

3.1.5 Switches

3.1.5.1 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.

3.1.5.2 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.

3.1.6 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.

3.1.6.1 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.

3.1.6.2 Duct Temperature Sensors

3.1.6.2.1 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.

3.1.6.2.2 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.

3.1.6.3 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.

3.1.6.4 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.

3.1.7 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.

3.1.8 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.

3.1.9 Relative Humidity Sensors

Install relative humidity sensors in supply air ducts at least 10 feet downstream of humidity injection elements.

3.1.10 Meters

3.1.10.1 Flowmeters

Install flowmeters to ensure minimum straight unobstructed piping in accordance with the manufacturer's installation instructions.

3.1.11 Dampers

3.1.11.1 Damper Actuators

Provide spring return actuators which fail to a position that protects the served equipment and space on all control dampers related to freeze protection or force protection. For all outside, makeup and relief dampers provide dampers which fail closed. Terminal fan coil units, terminal VAV units, convectors, and unit heaters may be non-spring return unless indicated otherwise. Do not mount actuators in the air stream. Do not connect multiple actuators to a common drive shaft. Install actuators so that their action seal the damper to the extent required to maintain leakage at or below the specified rate and so that they move the blades smoothly throughout the full range of motion.

3.1.11.2 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.

3.1.12 Valves

Install the valves in accordance with the manufacturer's instructions.

3.1.12.1 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.

3.1.13 Thermometers and Gauges

3.1.13.1 Thermometers

Mount devices to allow reading while standing on the floor or ground, as applicable.

3.1.14 Wire and Cable

Provide complete electrical wiring for the Control System, including wiring to transformer primaries. Wire and Cable must be installed without splices between control devices and in accordance with NFPA 70 and NFPA 90A. Instrumentation grounding must be installed per the device manufacturer's instructions and as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Test installed ground rods as specified in IEEE 142. Cables and conductor wires must be tagged at both ends, with the identifier indicated on the shop drawings. Electrical work must be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and as indicated. Wiring external to enclosures must be run in raceways, except low-voltage control and low-voltage network wiring may be installed as follows:

- a. plenum rated cable in suspended ceilings over occupied spaces may be run without raceways
- b. nonmetallic-sheathed cables or metallic-armored cables may be installed as permitted by NFPA 70.

Install control circuit wiring not in raceways in a neat and safe manner. Wiring must not use the suspended ceiling system (including tiles, frames or hangers) for support. Where conduit or raceways are required, control circuit wiring must not run in the same conduit/raceway as power wiring over 50 volts. Run all circuits over 50 volts in conduit, metallic tubing, covered metal raceways, or armored cable.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

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
 - 1.1.1 System Requirements
 - 1.1.2 Verification of Specification Requirements
- 1.2 REFERENCES
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS

PART 2 PRODUCTS

- 2.1 NETWORK HARDWARE
 - 2.1.1 BACnet Router
 - 2.1.2 BACnet Gateways
 - 2.1.3 Ethernet Switch
- 2.2 CONTROL NETWORK WIRING
- 2.3 DIRECT DIGITAL CONTROL (DDC) HARDWARE
 - 2.3.1 General Requirements
 - 2.3.2 Hardware Input-Output (I/O) Functions
 - 2.3.2.1 Analog Inputs
 - 2.3.2.2 Analog Outputs
 - 2.3.2.3 Binary Inputs
 - 2.3.2.4 Binary Outputs
 - 2.3.2.4.1 Relay Contact Closures
 - 2.3.2.4.2 Triac Outputs
 - 2.3.2.5 Pulse Accumulator
 - 2.3.2.6 ASHRAE 135 Objects for Hardware Inputs and Outputs
 - 2.3.2.7 Integrated H-O-A Switches
 - 2.3.3 Local Display Panel (LDP)
 - 2.3.4 Expansion Modules and Tethered Hardware
 - 2.3.5 Supervisory Control Requirements
 - 2.3.5.1 Scheduling Hardware
 - 2.3.5.2 Alarm Generation Hardware
 - 2.3.5.3 Trending Hardware

PART 3 EXECUTION

- 3.1 CONTROL SYSTEM INSTALLATION
 - 3.1.1 Building Control Network (BCN)
 - 3.1.1.1 Building Control Network IP Backbone
 - 3.1.1.2 BACnet MS/TP Networks
 - 3.1.1.3 Building Control Network (BCN) Installation
 - 3.1.2 DDC Hardware
 - 3.1.2.1 Device Identifiers, Network Addresses, and IP addresses
 - 3.1.2.2 Object Name Property and Object Description Property
 - 3.1.2.3 Hand-Off-Auto (H-O-A) Switches

- 3.1.2.4 Local Display Panels
- 3.1.2.5 MS/TP Slave Devices
- 3.1.2.6 Change of Value (COV) and Read Property
- 3.1.2.7 Engineering Units
- 3.1.2.8 Occupancy Modes
- 3.1.2.9 Use of BACnet Objects
- 3.1.2.10 Use of Standard BACnet Services
- 3.1.2.11 Device Application Configuration
- 3.1.3 Scheduling, Alarming, Trending, and Overrides
 - 3.1.3.1 Scheduling
 - 3.1.3.2 Configuration of Alarm Generation
 - 3.1.3.3 Support for Future Alarm Generation
 - 3.1.3.4 Trend Log Configuration
 - 3.1.3.5 Overrides
- 3.1.4 BACnet Gateways
 - 3.1.4.1 General Gateway Requirements

-- End of Section Table of Contents --

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 System Requirements

Provide a system meeting the requirements of both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section and with the following characteristics:

- a. Except for Gateways, the control system must be an open implementation of BACnet technology using ASHRAE 135 as the communications protocol. The system must use standard ASHRAE 135 Objects and Properties. The system must use standard ASHRAE 135 Services exclusively for communication over the network. Gateways to packaged units must communicate with other DDC hardware using ASHRAE 135 exclusively and may communicate with packaged equipment using other protocols. The control system must be installed such that any two devices on the Internetwork can communicate using standard ASHRAE 135 Services.
- b. Install and configure control hardware to provide ASHRAE 135 Objects and Properties as indicated and as needed to meet the requirements of this specification.

1.1.2 Verification of Specification Requirements

Review all specifications related to the control system installation and advise the Contracting Officer of any discrepancies before performing any work. If Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC or any other Section referenced in this specification is not included in the project specifications advise the Contracting Officer and either obtain the missing Section or obtain Contracting Officer approval before performing any work.

1.2 REFERENCES

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

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 135

(2020; Errata 2021) BACnet-A Data

Communication Protocol for Building
Automation and Control Networks

BACNET INTERNATIONAL (BTL)

BTL Guide (v.49; 2017) BACnet Testing Laboratory
Implementation Guidelines

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3 (2018) Ethernet

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-485 (1998a; R 2012) Electrical Characteristics
of Generators and Receivers for Use in
Balanced Digital Multipoint Systems

U.S. FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15 Radio Frequency Devices (47 CFR 15)

UNDERWRITERS LABORATORIES (UL)

UL 916 (2015) Standard for Energy Management
Equipment

1.3 DEFINITIONS

For definitions related to this section, see Section 23 09 00
INSTRUMENTATION AND CONTROL FOR HVAC.

1.4 SUBMITTALS

Submittal requirements related to this Section are specified in Section
23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

PART 2 PRODUCTS

All products used to meet this specification must meet the indicated
requirements, but not all products specified here will be required by
every project. All products must meet the requirements both Section
23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

The new BAS provided under this project must be fully compatible with and
integrated into the existing site-wide EMCS front-end/server, which is
also based on Delta Controls system.

2.1 NETWORK HARDWARE

2.1.1 BACnet Router

All BACnet Routers must be BACnet/IP Routers and must perform layer 3
routing of ASHRAE 135 packets over an IP network in accordance with
ASHRAE 135 Annex J and Clause 6. The router must provide the appropriate
connection to the IP network and connections to one or more ASHRAE 135
MS/TP networks. Devices used as BACnet Routers must meet the
requirements for DDC Hardware, and must support the NM-RC-B BIBB.

2.1.2 BACnet Gateways

In addition to the requirements for DDC Hardware, the BACnet Gateway must meet the following requirements:

- a. It must perform bi-directional protocol translation from one non-ASHRAE 135 protocol to ASHRAE 135. BACnet Gateways must incorporate a network connection to an ASHRAE 135 network (either BACnet over IP in accordance with Annex J or MS/TP) and a separate connection appropriate for the non-ASHRAE 135 protocol and media.
- b. It must retain its configuration after a power loss of an indefinite time, and must automatically return to their pre-power loss state once power is restored.
- c. It must allow bi-directional mapping of data between the non-ASHRAE 135 protocol and Standard Objects as defined in ASHRAE 135. It must support the DS-RP-B BIBB for Objects requiring read access and the DS-WP-B BIBB for Objects requiring write access.
- d. It must support the DS-COV-B BIBB.

Although Gateways must meet DDC Hardware requirements they are not DDC Hardware and must not be used when DDC Hardware is required.

2.1.3 Ethernet Switch

Ethernet Switches must 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 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.
- p. Devices communicating BACnet/IP must use UDP Port 0xBAC0. Devices with configurable UDP Ports must default to 0xBAC0.
- q. All Device IDs, Network Numbers, and BACnet MAC addresses of devices must be fully configurable without limitation, except MS/TP MAC addresses may be limited by ASHRAE 135 requirements.
- r. DDC Hardware controlling a single terminal unit must have:
 - (1) Objects (including the Device Object) with an Object Name Property of at least 8 characters in length.
 - (2) A configurable Device Object Name.
 - (3) A configurable Device Object Description Property at least 16 characters in length.
- s. Except for Objects in DDC Hardware controlling a single terminal unit, all Objects (including Device Objects) must:
 - (1) Have a configurable Object Name Property of at least 12 characters in length.
 - (2) Have a configurable Object Description Property of at least 24 characters in length.
- t. For programmable DDC Hardware, provide and license to the project site all programming software required to program the Hardware in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.
- u. For programmable DDC Hardware, provide copies of the installed application programs (all software that is not common to every controller of the same manufacturer and model) as source code compatible with the supplied programming software in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. The submitted application program must be the complete application necessary for controller to function as installed and be sufficient to allow replacement of the installed controller with another controller of the same type.

2.3.2 Hardware Input-Output (I/O) Functions

DDC Hardware incorporating hardware input-output (I/O) functions must meet the following requirements:

2.3.2.1 Analog Inputs

DC Hardware analog inputs (AIs) must be implemented using ASHRAE 135 Analog Input Objects and perform analog to digital (A-to-D) conversion with a minimum resolution of 8 bits plus sign or better as needed to meet the accuracy requirements specified in Section 23 09 00. Signal conditioning including transient rejection must be provided for each

analog input. Analog inputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. The AI must incorporate common mode noise rejection of at least 50 dB from 0 to 100 Hz for differential inputs, and normal mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10,000 ohms.

2.3.2.2 Analog Outputs

DDC Hardware analog outputs (AOs) must be implemented using ASHRAE 135 Analog Output Objects and perform digital to analog (D-to-A) conversion with a minimum resolution of 8 bits plus sign, and output a signal with a range of 4-20 mA_{dc} or 0-10 V_{dc}. Analog outputs must be capable of being individually calibrated for zero and span. Calibration via software scaling performed as part of point configuration is acceptable. DDC Hardware with Hand-Off-Auto (H-O-A) switches for analog outputs must provide for overriding the output through the range of 0 percent to 100 percent.

2.3.2.3 Binary Inputs

DDC Hardware binary inputs (BIs) must be implemented using ASHRAE 135 Binary Input Objects and accept contact closures and must ignore transients of less than 5 milli-second duration. Protection against a transient 50VAC must be provided.

2.3.2.4 Binary Outputs

DDC Hardware binary outputs (BOs) must be implemented using ASHRAE 135 Binary Output Objects and provide relay contact closures or triac outputs for momentary and maintained operation of output devices. DDC Hardware with H-O-A switches for binary outputs must provide for overriding the output open or closed.

2.3.2.4.1 Relay Contact Closures

Closures must have a minimum duration of 0.1 second. Relays must provide at least 180V of isolation. Electromagnetic interference suppression must be provided on all output lines to limit transients to 50 Vac. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.4.2 Triac Outputs

Triac outputs must provide at least 180 V of isolation. Minimum contact rating must be 0.5 amperes at 24 Vac.

2.3.2.5 Pulse Accumulator

DDC Hardware pulse accumulators must be implemented using either an ASHRAE 135 Accumulator Object or an ASHRAE 135 Analog Value Object where the Present_Value is the totalized pulse count. Pulse accumulators must accept contact closures, ignore transients less than 5 msec duration, protect against transients of 50 VAC, and accept rates of at least 20 pulses per second.

2.3.2.6 ASHRAE 135 Objects for Hardware Inputs and Outputs

The requirements for use of ASHRAE 135 objects for hardware input and outputs includes devices where the hardware sensor or actuator is integral

to the controller (e.g. a VAV box with integral damper actuator, a smart sensor, a VFD, etc.)

2.3.2.7 Integrated H-O-A Switches

Where integrated H-O-A switches are provided on hardware outputs, controller must provide means of monitoring position or status of H-O-A switch. This feedback may be provided via any valid BACnet method, including the use of proprietary Objects, Properties, or Services.

2.3.3 Local Display Panel (LDP)

The Local Display Panels (LDPs) must be DDC Hardware with a display and navigation buttons or a touch screen display, and must provide display and adjustment of ASHRAE 135 Properties as indicated on the Points Schedule and as specified. LDPs must be either BTL Listed as a B-OD, B-OWS, B-AWS, or be an integral part of another piece of DDC Hardware listed as a B-BC. For LDPs listed as B-OWS or B-AWS, the hardware must be BTL listed and the product must come factory installed with all applications necessary for the device to function as an LDP.

The adjustment of values using display and navigation buttons must be password protected.

2.3.4 Expansion Modules and Tethered Hardware

A single piece of DDC Hardware may consist of a base unit and also:

- a. An unlimited number of hardware expansion modules, where the individual hardware expansion modules are designed to directly connect, both mechanically and electrically, to the base unit hardware. The expansion modules must be commercially available as an optional add-on to the base unit.
- b. A single piece of hardware connected (tethered) to a base unit by a single cable where the cable carries a proprietary protocol between the base unit and tethered hardware. The tethered hardware must not contain control logic and be commercially available as an optional add-on to the base unit as a single package.

Note that this restriction on tethered hardware does not apply to sensors or actuators using standard binary or analog signals (not a communications protocol); sensors or actuators using standard binary or analog signals are not considered part of the DDC Hardware.

Hardware capable of being installed stand-alone, or without a separate base unit, is DDC Hardware and must not be used as expansion modules or tethered hardware.

2.3.5 Supervisory Control Requirements

2.3.5.1 Scheduling Hardware

DDC Hardware used for scheduling must meet the following requirements:

- a. It must be BTL Listed as a B-BC and support the SCHED-E-B BIBB.
- b. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Calendar and Schedule Objects, such that a front end BTL

listed as a B-AWS may create or delete Calendar and Schedule Objects. It is also preferred but not required that devices supporting the DM-OCD-B BIBB accept any valid value for properties of Calendar and Schedule Objects. Note that there are additional requirements in the EXECUTION Part of this Section for Devices which do not support the DM-OCD-B BIBB as specified.

- c. The Date_List property of all Calendar Objects must be writable.
- d. The Present_Value Property of Schedule must support the following values: 1, 2, 3, 4.

2.3.5.2 Alarm Generation Hardware

DDC Hardware used for alarm generation must meet the following requirements:

- a. Device must support the AE-N-I-B BIBB
- b. The Recipient_List Property must be Writable for all Notification Class Objects used for alarm generation.
- c. For all Objects implementing Intrinsic Alarming, the following Properties must be Writable:
 - (1) Time_Delay
 - (2) High_Limit
 - (3) Low_Limit
 - (4) Deadband
 - (5) Event_Enable
 - (6) If the issue date of this project specification is after 1 January 2016, Time_Delay_Normal must be writable.
- d. For Event Enrollment Objects used for alarm generation, the following Properties must be Writable:
 - (1) Event_Parameters
 - (2) Event_Enable
 - (3) If the issue date of this project specification is after 1 January 2016, Time_Delay_Normal must be writable.
- e. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Notification Class Objects and Event Enrollment Objects, such that a front end BTL listed as a B-AWS may create or delete Notification Class Objects and Event Enrollment Objects. It is also preferred, but not required that devices supporting the DM-OCD-B BIBB accept any valid value as an initial value for properties of Notification Class Objects and Event Enrollment Objects. Note that there are additional requirements in the EXECUTION Part of this Section for devices which do not support the DM-OCD-B BIBB as specified.
- f. Devices provided to meet the the requirements indicated under "Support for Future Alarm Generation" in the EXECUTION part of this specification must support the AE-N-E-B BIBB.

2.3.5.3 Trending Hardware

DDC Hardware used for collecting trend data must meet the following

requirements:

- a. Device must support Trend Log or Trend Log Multiple Objects.
- b. Device must support the T-VMT-I-B BIBB.
- c. Devices provided to meet the EXECUTION requirement for support of Future Trending must support the T-VMT-E-B BIBB.
- d. The following properties of all Trend Log or Trend Log Multiple Objects must be present and Writable:
 - Start_Time
 - Stop_Time
 - Log_DeviceObjectProperty
 - Log Interval Log interval must support an interval of at least 60 minutes duration.
- e. Trend Log Objects must support using Intrinsic Reporting to send a BUFFER_FULL event.
- f. The device must have a Notification Class Object for the BUFFER_FULL event. The Recipient_List Property must be Writable.
- g. Devices must support values of at least 1,000 for Buffer_Size Properties.
- h. It is preferred, but not required, that devices support the DM-OCD-B BIBB on all Trend Log Objects, such that a front end BTL listed as a A-AWS may create or delete Trend Log Objects. It is also preferred, but not required that devices supporting the DM-OCD-B BIBB accept any valid value as an initial value for properties of Trend Log Objects. Note that there are additional EXECUTION requirements for devices which do not support the DM-OCD-B BIBB as specified.

PART 3 EXECUTION

3.1 CONTROL SYSTEM INSTALLATION3.1.1 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 Government.
- b. Coordinate device IP addresses with the Government.

3.1.2.2 Object Name Property and Object Description Property

Configure the Object_Names and Object_Descriptions properties of all Objects (including Device Objects) as indicated on the Points Schedule (Point Name and Point Description) and as specified. At a minimum:

- a. Except for DDC Hardware controlling a single terminal unit, configure the Object_Name and Object_Description properties of all Objects (including Device Objects) as indicated on the Points Schedule and as specified.
- b. In DDC Hardware controlling a single terminal unit, configure the Device Object_Name and Device Object_Description as indicated on the Points Schedule and as specified.

When Points Schedule entries exceed the length limitations in the device, notify the Government 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 as specified and as indicated on the Points Schedule. Provide H-O-A switches that are integral to the controller hardware, an external device co-located with (in the same enclosure as) the controller, integral to the controlled equipment, or an external device co-located with (in the same enclosure as) the controlled equipment.

- a. For H-O-A switches integral to DDC Hardware, meet the requirements specified in paragraph DIRECT DIGITAL CONTROL (DDC) HARDWARE.
- b. For external H-O-A switches used for binary outputs, provide for overriding the output open or closed.
- c. For external H-O-A switches used for analog outputs, provide for overriding through the range of 0 percent to 100 percent.

3.1.2.4 Local Display Panels

Provide LDPs to display 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. Steam flow in pounds per hour (pph)
- e. Differential Air pressures in inches of water column (IWC)
- f. Water, steam, and natural gas pressures in PSI
- g. Enthalpy in BTU/lb
- h. Heating and cooling energy in MBTU (1MBTU = 1,000,000 BTU)
- i. Cooling load in tons (1 ton = 12,000 BTU/hour)
- j. Heating load in MBTU/hour (1MBTU = 1,000,000 BTU)
- k. Electrical Power: kilowatts (kW)
- l. Electrical Energy: kilowatt-hours (kWh)

3.1.2.8 Occupancy Modes

Use the following correspondence between value and occupancy mode whenever an occupancy state or value is required:

- a. OCCUPIED mode: a value of one
- b. UNOCCUPIED mode: a value of two
- c. WARM-UP/COOL-DOWN (PRE-OCCUPANCY) mode: a value of three

Note that elsewhere in this Section the Schedule Object is required to

also support a value of four, which is reserved for future use. Also note that the behavior of a system in each of these occupancy modes is indicated in the sequence of operation for the system.

3.1.2.9 Use of BACnet Objects

Use only standard non-proprietary ASHRAE 135 Objects and services to accomplish the project scope of work as follows:

- a. Use Analog Input or Analog Output Objects for all analog hardware I/O. Do not use Analog Value Object for analog hardware I/O) .
- b. Use Binary Input or Binary Output Objects for all binary hardware I/O. Do not use Binary Value Objects for binary hardware I/O.
- c. Use Analog Value Objects for analog setpoints.
- d. Use Accumulator Objects or Analog Value Objects for pulse inputs.
- e. For occupancy modes, use Multistate Value Objects and the correspondence between value and occupancy mode specified in paragraph OCCUPANCY MODES.
- f. Use Schedule Objects and Calendar Objects for all scheduling. Use Trend Log Objects or Trend Log Multiple Objects for all trending and Notification Class Objects for trend log upload. Use a combination of Event Enrollment Objects, Intrinsic Alarming, and Notification Class Objects for alarm generation.
- g. For all other points shown on the Points Schedule as requiring an ASHRAE 135 Object, use the Object type shown on the Points Schedule or, if no Object Type is shown, use a standard Object appropriate to the point.

3.1.2.10 Use of Standard BACnet Services

Except as noted in this paragraph, for all DDC Hardware use Standard BACnet Services as defined in this specification (which excludes some ASHRAE 135 services) exclusively for application control functionality and communication.

DDC Hardware that cannot meet this requirement may use non-standard services provided they can provide identical functionality using Standard BACnet Services when communicating with BACnet devices from a different vendor. When implementing non-standard services, document all non-standard services in the DDC Hardware Schedule as specified and as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

3.1.2.11 Device Application Configuration

- a. For every property, setting or value shown on the Points Schedule or otherwise indicated as Configurable, provide a value that is retained through loss of power and can be changed via one or more of:
 - (1) BACnet services (including proprietary services)
 - (2) Hardware settings on the device

- b. For every property, setting or value shown on the Points Schedule or otherwise indicated as Operator Configurable, provide a value that is retained through loss of power and can be changed via one or more of:

- (1) A Writable Property of a standard BACnet Object
- (2) A Property of a standard BACnet Object that is Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable.

3.1.3 Scheduling, Alarming, Trending, and Overrides

3.1.3.1 Scheduling

Configure schedules in BACnet Scheduling Objects to schedule systems as indicated on the Points Schedule and as specified using the indicated correspondence between value and occupancy mode. If no devices supports both the SCHED-E-B and DM-OCD-B BIBBS for Schedule Objects, provide 5 blank Schedule Objects in DDC Hardware BTL listed as B-BCs and supporting the SCHED-E-B BIBB for later use by the site.

Provide a separate schedule for each AHU including it's associated Terminal Units and for each stand-alone Terminal Unit (those not dependent upon AHU service) or group of stand-alone Terminal Units acting according to a common schedule.

3.1.3.2 Configuration of Alarm Generation

- a. Send alarm events as Alarms (not Events).
- b. Use the ConfirmedNotification Service for alarm events.
- c. For alarm generation, support two priority levels for alarms: critical and non-critical. Configure the Priority of Notification Class Objects to use Priority 112 for critical and 224 for non-critical alarms.
- d. Number of Notification Class Objects for Alarm Generation:
 - (1) If the device implements non-critical alarms, or if any Object in the device supports Intrinsic Alarms, then provide a single Notification Class Object specifically for (shared by) all non-critical alarms.
 - (2) If the device implements critical alarms, provide a single Notification Class Object specifically for (shared by) all critical alarms.
 - (3) If the device implements both critical and non-critical alarms, provide both Notification Class Objects (one for critical, one for non-critical).
 - (4) If the device controls equipment other than a single terminal unit, provide both Notification Class Objects (one for critical, one for non-critical) even if no alarm generation is required at time of installation.
- e. For all intrinsic alarms configure the Limit_Enable Property to set both HighLimitEnable and LowLimitEnable to TRUE. If the specified alarm conditions are for a single-sided alarm (only High_Limit used or

only Low_Limit used) assign a value to the unused limit such that the unused alarm condition will not occur.

- f. For all objects supporting intrinsic alarming, even if no alarm generation is required during installation, configure the following Properties as follows:
 - (1) Notification_Class to point to the non-Critical Notification Class Object in that device.
 - (2) Limit_Enable to enable both the HighLimitEnable and LowLimitEnable
 - (3) Notify_Type to Alarm
- g. Use of alarm generation types:
 - (1) Only use algorithmic alarm generation when intrinsic alarm generation is not supported by the device or object, or when the specific alarm conditions cannot be implemented using intrinsic alarm generation.
 - (2) Only use remote alarm generation when the alarm cannot be generated using intrinsic or local algorithmic alarm generation on the device containing the referenced property. If remote alarm generation is used, use the same DDC Hardware for all remote alarm generation within a single sequence.

3.1.3.3 Support for Future Alarm Generation

For every piece of DDC Hardware, support future alarm generation capabilities by supporting either intrinsic or additional algorithmic alarming. Provide one of the following:

- a. Support intrinsic alarming for every Object used by the application in that device.
- b. Support additional Event_Enrollment Objects. For DDC hardware controlling a single terminal unit, support at least one additional object. Otherwise, support at least 4 additional Objects. Support additional Event_Enrollment Objects via one of the following:
 - (1) Provide unused Event_Enrollment Objects on that device.
 - (2) Support the DM-OCD-B BIBB and the creation of sufficient Event_Enrollment Objects on that device.
 - (3) Provide one or more devices in the IP network that support the AE-N-E-B BIBB and have unused Event_Enrollment Objects.
 - (4) Provide one or more devices on the IP network that support the AE-N-E-B BIBB, the DM-OCD-B BIBB, and the creation of sufficient Event_Enrollment Objects.

The total number of Event_Enrollment Objects required by the project is the sum of the individual device requirements, and the distribution of Event_Enrollment Objects among devices is not further restricted. (Note this allows a single device to contain many Event_Enrollment Objects satisfying the requirements for multiple devices.)

3.1.3.4 Trend Log Configuration

- a. Configure trends in Trend Log or Trend Log Multiple Objects as indicated on the Points Schedule and as specified.
- b. Configure all trend logs (including any provided to support future trends) to save data on regular intervals using the BUFFER_FULL event to request trend upload from the front end.
- c. Configure Trend Log Objects with a minimum Buffer_Size property value of 1,000 and Trend Log Multiple Objects with a minimum Buffer_Size property value of 1,000 per point trended (for example, a Trend Log Multiple Object used to trend 3 points must have a Buffer_Size Property value of at least 3,000).
- d. Configure a Notification Class Object in devices doing trending (including devices supporting future trends) to handle the BUFFER_FULL event.
- e. When possible, trend each point using an Object in the device containing the point. When it is necessary to trend using a an Object in another device, all trends not on the same Device as the Object being trended must be on a single device (i.e. all Trend Log and Trend Log Multiple Objects used for remote trending within a sequence must be on the same device).
- f. For each trend log, including any trend logs provided to support future trending, configure the following properties as specified:
 - (1) Logging_Type: Set to Polling
 - (2) Stop_When_Full: Set to Wrap Around
 - (3) Buffer_Size: Set to 400 or greater.
 - (4) Notification_Threshold: Set to 90 percent of full
 - (5) Notification_Class: Set to the Notification Class Object in that device
 - (6) Event_Enable: Set to TRUE
 - (7) Log_Interval: Set to 15 minutes.
- 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 . With specific approval from the Contracting Officer, Overrides for points which are not hardware outputs and which are in DDC hardware controlling a single terminal unit may support overrides via an additional Object provided for the override. No other means of implementing Overrides may be used.

- a. Where Commandable Objects are used, ensure that WriteProperty service requests with a Priority of 10 or less take precedence over the SEQUENCE VALUE and that WriteProperty service request with a priority of 11 or more have a lower precedence than the SEQUENCE VALUE.
- b. For devices implementing overrides via additional Objects, provide Objects which are NOT Written to as part of the normal Sequence of Operations and are Writable when Out_Of_Service is TRUE and Out_Of_Service is Writable. Use this point as an Override of the normal value when Out_Of_Service is TRUE and the normal value otherwise. Note these Objects may be modified as part of the sequence via local processes, but must not be modified by local processes when Out_Of_Service is TRUE.

3.1.4 BACnet Gateways

The requirements in this paragraph do not themselves permit the installation of hardware not meeting the other requirements of this section. Except for proprietary systems specifically indicated in Section 23 09 00, all control hardware installed under this project must meet the requirements of this specification, including the control hardware providing the network interface for a package unit or split system specified under another section. Only use gateways to connect to pre-existing control devices, and to proprietary systems specifically permitted by Section 23 09 00.

3.1.4.1 General Gateway Requirements

Provide BACnet Gateways to connect non-BACnet control hardware in accordance with the following:

- a. Configure gateways to map writable data points in the controlled equipment to Writable Properties of Standard Objects as indicated in the Points Schedule and as specified.
- b. Configure gateway to map readable data points in the controlled equipment to Readable Properties of Standard Objects as indicated in the Points Schedule and as specified.
- c. Configure gateway to support the DS-COV-B BIBB for all points mapped to BACnet Objects.
- d. Do not use non-BACnet control hardware for controlling built-up units or any other equipment that was not furnished with factory-installed controls.

- e. Do not use non-BACnet control hardware for system scheduling functions.
- f. Each gateway must communicate with and perform protocol translation for non-BACnet control hardware controlling one and only one package unit or a single non-BACnet system specifically permitted by Section 23 09 00.
- g. Connect one network port on the gateway to the Building Control Backbone IP Network or to a BACnet MS/TP network and the other port to the single piece of controlled equipment or the non-BACnet system specifically permitted by Section 23 09 00..
- h. For gateways to existing package units or simple split systems, non-BACnet network wiring connecting the gateway to the package unit must not exceed 10 feet in length and must connect to exactly two devices: the controlled equipment (packaged unit) or split system interface and the gateway.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 11 20

FACILITY GAS PIPING

05/20

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 REFERENCES
- 1.3 SYSTEM DESCRIPTION
 - 1.3.1 Gas Facility System and Equipment Operation
 - 1.3.2 Gas Facility System Maintenance
 - 1.3.3 Gas Facility Equipment Maintenance
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Welding Qualifications
 - 1.5.2 Jointing Thermoplastic Piping
 - 1.5.3 Shop Drawings
- 1.6 DELIVERY, STORAGE, AND HANDLING
 - 1.6.1 Plastic Pipe

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
- 2.2 GAS PIPING SYSTEM AND FITTINGS
 - 2.2.1 Steel Pipe, Joints, and Fittings
 - 2.2.2 Steel Tubing, Joints and Fittings
 - 2.2.3 Thermoplastic Pipe, Tubing, Joints, and Fittings
 - 2.2.4 Corrugated Stainless Steel Tubing, Fittings and Accessories
 - 2.2.4.1 Tubing
 - 2.2.4.2 Mechanical Fittings
 - 2.2.4.3 Striker Plates
 - 2.2.4.4 Manifolds
 - 2.2.5 Sealants for Steel Pipe Threaded Joints
 - 2.2.6 Warning and Identification
 - 2.2.7 Flange Gaskets
 - 2.2.8 Pipe Threads
 - 2.2.9 Escutcheons
 - 2.2.10 Gas Transition Fittings
 - 2.2.11 Insulating Pipe Joints
 - 2.2.11.1 Insulating Joint Material
 - 2.2.11.2 Threaded Pipe Joints
 - 2.2.11.3 Flanged Pipe Joints
 - 2.2.12 Flexible Connectors
- 2.3 VALVES
 - 2.3.1 Valves 2 Inches and Smaller
 - 2.3.2 Valves 2-1/2 Inches and Larger
- 2.4 RISERS
- 2.5 PIPE HANGERS AND SUPPORTS
- 2.6 LINE AND APPLIANCE REGULATORS AND SHUTOFF VALVES
- 2.7 NATURAL GAS SERVICE

- 2.7.1 Service Regulators
- 2.7.2 Gas Meter
 - 2.7.2.1 Utility Monitoring and Control System (UMCS) / Energy Monitoring and Control (EMCS) or Automatic Meter Reading Interfaces
 - 2.7.2.2 Measurement Configuration
- 2.8 AUTOMATIC GAS SHUT-OFF
- 2.9 BOLTING (BOLTS AND NUTS)
- 2.10 GASKETS
- 2.11 IDENTIFICATION FOR ABOVEGROUND PIPING

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 EXCAVATION AND BACKFILLING
- 3.3 GAS PIPING SYSTEM
 - 3.3.1 Protection and Cleaning of Materials and Components
 - 3.3.2 Workmanship and Defects
- 3.4 PROTECTIVE COVERING
 - 3.4.1 Underground Metallic Pipe
 - 3.4.2 Aboveground Metallic Piping Systems
 - 3.4.2.1 Ferrous Surfaces
 - 3.4.2.2 Nonferrous Surfaces
- 3.5 INSTALLATION
 - 3.5.1 Metallic Piping Installation
 - 3.5.2 Metallic Tubing Installation
 - 3.5.3 Thermoplastic Piping, Tubing, and Fittings
 - 3.5.4 Connections Between Metallic and Plastic Piping
 - 3.5.5 Piping and Tubing Buried Under Buildings
 - 3.5.6 Concealed Piping in Buildings
 - 3.5.6.1 Piping and Tubing in Partitions
 - 3.5.6.2 Piping in Floors
 - 3.5.7 Aboveground Piping
 - 3.5.8 Final Gas Connections
 - 3.5.9 Meter Installation
- 3.6 PIPE JOINTS
 - 3.6.1 Threaded Metallic Joints
 - 3.6.2 Welded Metallic Joints
 - 3.6.3 Thermoplastic Joints
 - 3.6.3.1 Thermoplastic
 - 3.6.3.2 PE Fusion Welding Inspection
 - 3.6.4 Flared Metallic Tubing Joints
- 3.7 PIPE SLEEVES
- 3.8 PIPES PENETRATING WATERPROOFING MEMBRANES
- 3.9 FIRE SEAL
- 3.10 ESCUTCHEONS
- 3.11 SPECIAL REQUIREMENTS
- 3.12 BUILDING STRUCTURE
- 3.13 PIPING SYSTEM SUPPORTS
- 3.14 ELECTRICAL BONDING AND GROUNDING
- 3.15 SHUTOFF VALVE
- 3.16 LINE AND APPLIANCE PRESSURE REGULATORS
- 3.17 GAS SERVICE INSTALLATION
 - 3.17.1 Service Line
 - 3.17.2 Service Regulator
 - 3.17.3 Gas Meter
- 3.18 TESTING
 - 3.18.1 Pressure Tests
 - 3.18.2 Test With Gas
 - 3.18.3 Purging

Joint Cryptologic Center Building - Buckley SFB, CO

BU81

3.18.4 Labor, Materials and Equipment
3.19 PIPE COLOR CODE MARKING

-- End of Section Table of Contents --

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" , "Fuel Gas Piping".

Refer to Section 33 51 15, NATURAL-GAS DISTRIBUTION PIPELINES for natural gas piping requirements outside of the building.

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 XR0603	(2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service
AGA Z223.1	(2012) National Fuel Gas Code

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.15/CSA 9.1	(2009; Addenda A 2012, Addenda B 2013; R 2019) 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	(2015; R 2020) Connectors for Gas Appliances
ANSI Z21.41/CSA 6.9	(2014; R 2019) Quick-Disconnect Devices for Use with Gas Fuel Appliances
ANSI Z21.69/CSA 6.16	(2015; R 2020) Connectors for Movable Gas Appliances
ANSI Z21.78/CSA 6.20	(2010; R 2020) Standard Specification for Combination Gas Controls for 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 570	(2016; Addendum 1 2017; Addendum 2 2018; ERTA 1 2018) Piping Inspection Code: In-Service Inspection, Rating, Repair, and Alteration of Piping Systems
API RP 2009	(2002; R 2007; 7th Ed) Safe Welding, Cutting, and Hot Work Practices in Refineries, Gasoline Plants, and Petrochemical Plants
API Spec 5CT	(2018) Casing and Tubing
API Spec 6D	(June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) Specification for Pipeline and Piping Valves
API Std 598	(2009) Valve Inspecting and Testing
API Std 607	(2016) Fire Test for Quarter-turn Valves and Valves Equipped with Non-metallic Seats

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2020) Scheme for the Identification of Piping Systems
ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.5	(2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard

ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(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 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, 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	(2015; Errata 2016) Welded and Seamless Wrought Steel Pipe
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 01.01	(2019) Steel - Piping, Tubing, Fittings
ASTM A105/A105M	(2021) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A181/A181M	(2014; R 2020) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
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 D2513 (2018a) Standard Specification for
Polyethylene (PE) Gas Pressure Pipe,
Tubing, and Fittings

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 3.16-M88 (2015) Lever Operated Non-Lubricated Gas
Shut-Off Valves

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; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101 (2014; Rev C) Color Code for Pipelines and
for Compressed Gas Cylinders

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 192 Transportation of Natural and Other Gas by
Pipeline: Minimum Federal Safety Standards

UNDERWRITERS LABORATORIES (UL)

UL FLAMMABLE & COMBUSTIBLE (2012) Flammable and Combustible Liquids
and Gases Equipment Directory

1.3 SYSTEM DESCRIPTION

The gas piping system includes natural gas and 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 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

Gas Piping System; G

SD-03 Product Data

Pipe and Fittings; G

Gas Equipment Connectors; G

Gas Piping System; G

Pipe Coating Materials; G

Pressure Regulators; G

Risers; G

Transition Fittings; G

Valves; G

Warning and Identification Tape; G

SD-06 Test Reports

Testing; G

Pressure Tests; G

Test with Gas; G

SD-07 Certificates

Welders Procedures and Qualifications; G

Assigned Number, Letter, or Symbol; G

SD-08 Manufacturer's Instructions

PE Pipe and Fittings; G

Pipe Coating Materials; G

SD-10 Operation and Maintenance Data

Gas Facility System and Equipment Operation; G

Gas Facility System Maintenance; G

Gas Facility Equipment Maintenance; G

1.5 QUALITY ASSURANCE

Submit manufacturer's descriptive data and installation instructions for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Mark all valves, flanges and fittings in accordance with MSS SP-25.

1.5.1 Welding Qualifications

- a. Weld piping in accordance with qualified procedures using performance qualified welders and welding operators in accordance with API RP 2009, ASME BPVC SEC IX, and ASME B31.9. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.9. Notify the Contracting Officer at least 24 hours in advance of tests, and perform at the work site if practicable.
- b. Submit a certified copy of welders procedures and qualifications metal and PE in conformance with ASME B31.9 for each welder and welding

operator. Submit the assigned number, letter, or symbol that will be used in identifying the work of each welder to the Contracting Officer.

Weld all structural members in accordance with Section 05 12 00 STRUCTURAL STEEL, and in conformance with AWS A5.8/A5.8M, and AWS WHB-2.9.

1.5.2 Jointing Thermoplastic Piping

Perform all jointing of piping using qualified joiners and qualified procedures in accordance with AGA XR0603. Furnish the Contracting Officer with a copy of qualified procedures and list of and identification symbols of qualified joiners. Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart, including all PE pipe and fittings.

1.5.3 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 Plastic Pipe

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe and fittings ends during transportation or storage to minimize dirt and moisture entry. Do not subject piping to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have 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 54 and with requirements specified herein. Provide supply piping to appliances or equipment at least as large as the inlets thereof.

2.2 GAS PIPING SYSTEM AND FITTINGS

2.2.1 Steel Pipe, Joints, and Fittings

Provide steel pipe conforming to ASME B36.10M; and malleable-iron threaded fittings conforming to ASME B16.1 and ASME B16.3. Provide steel pipe flanges and flanged fittings, including bolts, nuts, and bolt pattern in accordance with ASME B16.5 and ASTM A105/A105M. Provide wrought steel butt welding fittings conforming to ASME B16.9. Provide socket welding and threaded forged steel fittings conforming to ASME B16.11 and ASTM A181/A181M, Class 60.

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 Thermoplastic Pipe, Tubing, Joints, and Fittings

Provide polyethylene yellow thermoplastic pipe, tubing, casing and joints and fittings conforming to ASTM D2513 and API Spec 5CT.

2.2.4 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.

2.2.4.1 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

2.2.4.2 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

2.2.4.3 Striker Plates

Hardened steel designed to protect tubing from mechanical damage in accordance with ANSI LC 1/CSA 6.26

2.2.4.4 Manifolds

Malleable iron, steel or copper alloy with threaded connections/ports in accordance with ASME B1.20.1

2.2.5 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.

2.2.6 Warning and Identification

Provide pipe flow markings, warning and identification tape, and metal tags as required.

2.2.7 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.

2.2.8 Pipe Threads

Provide pipe threads conforming to ASME B1.20.1.

2.2.9 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.

2.2.10 Gas Transition Fittings

- a. Provide steel to plastic (PE) designed for steel-to-plastic with tapping tee or sleeve conforming to AGA XR0603 requirements for transitions fittings.. Coat or wrap exposed steel pipe with heavy plastic coating.
- b. Provide lever operated non-lubricated gas shut-off valves conforming to CGA 3.16-M88

2.2.11 Insulating Pipe Joints

2.2.11.1 Insulating Joint Material

Provide insulating joint material between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.2.11.2 Threaded Pipe Joints

Provide threaded pipe joints of steel body nut type dielectric unions with insulating gaskets.

2.2.11.3 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.

2.2.12 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. Provide combination gas controls for gas appliances conforming to ANSI Z21.78/CSA 6.20.
- 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 RISERS

Provide manufacturer's standard riser, transition from plastic to steel pipe with 7 to 12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide remote bolt-on or bracket or wall-mounted riser supports .

2.5 PIPE HANGERS AND SUPPORTS

Provide pipe hangers and supports conforming to MSS SP-58.

2.6 LINE AND APPLIANCE REGULATORS AND SHUTOFF VALVES

Provide regulators conforming to ANSI Z21.18/CSA 6.3 for appliances ANSI Z21.78/CSA 6.20 for combination gas controls for gas 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.

2.7 NATURAL GAS SERVICE

2.7.1 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. Adjust regulators for liquified petroleum gas to 2.5 to 3 kPa 10 to 12 inches of water column, with pressure relief set at 4 kPa 16 inches of water column.
- c. 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 exceed 2 inch size.

2.7.2 Gas Meter

AGA ANSI B109.1AGA ANSI B109.2 pedestal mounted, diaphragm style, enamel-coated steel case. Provided with a strainer immediately upstream. 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 frost protection and fungus 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.

AMRS compatible gas metering solutions consist of a componential system to achieve the goal of delivering gas consumption data into the AMRS. To accurately scale output pulses the contractor must obtain building gas usage from base personnel, taking into account peak demand when sizing the components that are necessary as well as determining peak pulse rate as to not saturate the receiving device and risk losing captured pulse data. The various components that may be necessary include but are not limited to the following: Gas Meter, Pulse Kit, High Speed Dividing Pulse Relay, Surge Suppression Device, Accumulator and Electric Meter with digital input availability:

- a. Pulse kit must be able to produce a two-wire (Form A) pulse output via RS485.
- b. Gas meter or attached pulse kit must include a visual register or dial.
- c. Pulse output must be delivered to a high speed dividing pulse relay that has the capability of producing a wetting voltage if necessary.
- d. High speed dividing pulse relay must provide isolated pulse outputs (Form A) that must be delivered to an AMRS compatible electric meter.
- e. Gas meters that can communicate to AMRS via the Modbus/TCP protocol may be acceptable if they can pass technical and cybersecurity evaluations directed by the AMRS PMO. At this time there are no tested or approved Modbus /TCP gas meters.
- f. All meter labels must be white on black phenolic.

The following list of meters were evaluated, meet the AMRS meter specification and must function within the AMRS platform. All networked devices, their integrated firmware and software will be approved by the PMO for use in the AMRS. PMO approval is contingent upon the device, in its fielded configuration, passing USAF cyber and AMRS compatibility testing.

- a. Schneider Electric PM5560
- b. Schneider Electric PM8000
- c. Schneider Electric ION 8650
- d. Siemens 9410
- e. Siemens 9810
- f. Schneider Electric ION 8600 (currently connected to AMRS only, no new installs)
- g. Electro Industries Nexus 1272 (currently connected to AMRS only, no new installs)
- h. Electro Industries Nexus 1262 (currently connected to AMRS only, no new installs)
- i. Schneider Electric PM800 (currently connected to AMRS only, no new installs)

The following device is compatible with the AMRS platform, is consistent

with the need of the existing site conditions, and has been tested and passed cybersecurity requirements:

a. Schneider Electric EGX150 Ethernet Gateway

2.7.2.1 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. Meters installed must comply with Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM.

2.7.2.2 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.

2.8 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). Provide low pressure automatic gas shutoff or excess flow valve (EFV) at each branch to an appliance.

2.9 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.

2.10 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.11 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes

and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy or areas of conflict before performing the work.

3.2 EXCAVATION AND BACKFILLING

Provide required excavation, backfilling, and compaction as specified in Section 31 00 00 EARTHWORK.

3.3 GAS PIPING SYSTEM

Provide a gas piping system from the point of delivery, defined as the outlet of the meter set assembly service regulator and shutoff valve, as specified under "Gas Service" within this specification, to the connections to each gas utilization device that is in compliance with NFPA 54.

3.3.1 Protection and Cleaning of Materials and Components

Protect equipment, pipe, and tube openings by closing with caps or plugs during installation. At the completion of all work, thoroughly clean the entire system.

3.3.2 Workmanship and Defects

Piping, tubing and fittings must be clear and free of cutting burrs and defects in structure or threading and must be thoroughly brushed and chip-and scale-blown. Repair of defects in piping, tubing or fittings is not allowed; replace defective items when found.

3.4 PROTECTIVE COVERING

3.4.1 Underground Metallic Pipe

Provide service entrance piping up to natural gas meter. Protect buried metallic piping and tubing from corrosion by either: (1) applying protective coatings as specified in Section 33 51 15 NATURAL-GAS / LIQUEFIED PETROLEUM GAS DISTRIBUTION PIPELINES; (2) encasement in a water tight plastic conduit; or (3) encasement in a protective system designed and listed by the manufacturer for this application. When dissimilar metals are joined underground, gastight insulating fittings must be used.

3.4.2 Aboveground Metallic Piping Systems

3.4.2.1 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 oil paint .

3.4.2.2 Nonferrous Surfaces

Except for aluminum alloy pipe, do not paint nonferrous surfaces. Paint surfaces of aluminum alloy pipe and fittings to protect against external corrosion where they contact masonry, plaster, insulation, or are subject to repeated wettings by such liquids as water, detergents or sewage. Solvent-clean the surfaces and treat with vinyl type wash coat. Apply a first coat of aluminum paint and a second coat of alkyd gloss enamel or silicone alkyd copolymer enamel.

3.5 INSTALLATION

Install the gas system in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54NFPA 58 and AGA XR0603, and as indicated. Perform all pipe cutting without damage to the pipe, with an approved type of mechanical cutter, unless otherwise authorized. Use wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas cutting and beveling machine may be used. Cut thermoplastic and fiberglass pipe in accordance with AGA XR0603.

3.5.1 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.

3.5.2 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'.

3.5.3 Thermoplastic Piping, Tubing, and Fittings

Installation of thermoplastic and fiberglass piping, tubing, and fittings is permitted only outside and underground. Bury piping a minimum of 18 inches below grade. Install the piping to avoid excessive stresses due to thermal contraction, and use only where indicated. Installations must be made using qualified procedures, by qualified installers, and in compliance with AGA XR0603 and NFPA 54 , and must be inspected by a qualified inspector.

3.5.4 Connections Between Metallic and Plastic Piping

Connections between metallic and plastic piping are only allowed outside, underground, and with approved transition fittings.

3.5.5 Piping and Tubing Buried Under Buildings

Run underground piping and tubing installed beneath buildings in a steel pipe casing protected from corrosion with protective coatings as specified in Section 33 51 15 NATURAL-GAS / LIQUEFIED PETROLEUM GAS DISTRIBUTION PIPELINES or installed within a water tight plastic conduit or as part of a listed encasement system. Extend casing or encasement system at least 4 inches outside the building, and provide the pipe with spacers and end bushings to seal at both ends to prevent the entrance of water and/or the escape of gas. Extend a vent line from the annular space above grade outside to a point where gas will not be a hazard, and terminate in a rain/insect-resistant fitting.

3.5.6 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.

3.5.6.1 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.

3.5.6.2 Piping in Floors

Natural gas piping must route into the building above grade and must not be located underneath building footprint slabs or floors.

3.5.7 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.

3.5.8 Final Gas Connections

Unless otherwise specified, make final connections with rigid metallic pipe and fittings. Make final connections to kitchen ranges using flexible connectors not less than 40 inch long, to afford access to coupling and to permit movement of equipment for cleaning. Flexible connectors may be used for final connections to gas utilization equipment.

In addition to cautions listed in instructions required by ANSI standards for flexible connectors, insure that flexible connectors do not pass through equipment cabinet. Provide accessible gas shutoff valve and coupling for each gas equipment item.

3.5.9 Meter Installation

Contractor must assume all existing equipment is working properly. If during the post award survey portion of the SOW an existing piece of equipment is found to be malfunctioning, then the contractor must bring it to the government's attention to determine how to proceed. An RFI must be

submitted. This may require a contract change to delete this meter from the scope or to add a new meter.

All due diligence to survey the existing site conditions is the responsibility of the contractor.

New and relocated electric meters must be installed adjacent to the main distribution panel in a separate enclosure unless otherwise noted.

All new and relocated meter assemblies be located approximately 5 feet above the ground (4 feet minimum -- 6 feet maximum).

All new meter installations, including relocated existing meters, must include the installation of new properly sized split or solid core current transformers (CTs). Accurate sizing of new CTs is the responsibility of the contractor.

If CT installation method includes disturbing the bonds of existing cables or wiring within the gear, before and after IR scans must be performed before removing and after torqueing the connections to ensure the integrity of the conductor bonds.

All new meter installations, including relocated existing meters, three phase voltage must be supplied from a breaker, disconnect or fused source which must be finger safe, labeled at the electrical meter and electrical panel.

All meter safety disconnect switches must be marked as follows "Meter Disconnect NOT Service Equipment" per the NEC. In addition, instructions to safely engage the safety disconnect switches and finger safe shorting blocks for CT conductors must be included inside each meter assembly.

Meter assemblies must be provided with finger safe voltage and current safety disconnect devices or equivalent so that the meter assembly can be worked on safely over the life of the meter installation and not require utility outages for servicing. Additionally, meters must have control power regardless of breaker position when installed in a split buss switchgear.

In the event communications equipment and/or a metering device has to be located in an exterior location, the meter enclosure must be a lockable NEMA 4 enclosure. All new install interior meters are required to be enclosed in a lockable NEMA 3 enclosure unless otherwise noted.

All new meter installations, including relocated existing meters, must be connected via CAT6 cable from the meter, to a wall outlet in the mechanical room, to a patch panel in the communications room, and then to the Air Force switch in the communications room.

Cables labels must be permanent, wrap-around and self-laminating with text generated by a mechanical device. Labels must be applied at both ends of the cable, visible during normal maintenance of the infrastructure, resistant to environmental conditions (such as moisture, heat or ultraviolet light), and have a design life equal to or greater than that of the labeled component.

Preferred technical approach to network communication cabling in excess of 328 feet is: Fiber optic cable and fiber media converters with dedicated power outlets. Fiber media converter must be installed in the

communications room within 6 feet of the network switch and within 6 feet of the electric meter enclosure.

All meter labels must be white on black phenolic.

All data cable test results (including fiber) must be completed only after the cable has been terminated in its permanent location, temporary cable test results will not be accepted.

Surge protection is required on all communication cabling extending from the exterior to the interior of a facility. This includes gas meter communication cables from the exterior to the interior of the building. Surge suppression devices must be installed w/in 3 feet of the building entrance inside the facility unless otherwise noted. Devices must be easily accessible and labeled to aide in location during future troubleshooting efforts. Surge protection devices must be Power over Ethernet (PoE) compatible and housed within an enclosure that allows space for a proper cable bend radius.

Meter assemblies and communication receptacles accessible to the public must be installed in a locked enclosure.

Electric meters with gas or water meters connected must have two internal registers configured - one for a raw pulse count and one for a weighted pulse count based on the scaling of the connected gas or water meter.

3.6 PIPE JOINTS

Design and install pipe joints to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.6.1 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.

3.6.2 Welded Metallic Joints

Conform beveling, alignment, heat treatment, and inspection of welds to NFPA 54. Remove weld defects and make repairs to the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect and store so that its characteristics or welding properties are not affected adversely. Do not use electrodes that have been wetted or have lost any of their coating.

3.6.3 Thermoplastic Joints

3.6.3.1 Thermoplastic

Conform jointing procedures to AGA XR0603. Do not make joints with solvent cement or heat of fusion between different kinds of plastics.

3.6.3.2 PE Fusion Welding Inspection

Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect, in conformance with API 570, 100 percent of all joints and re-inspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the Contracting Officer to make first time inspection.

3.6.4 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.

3.7 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. For penetrations of fire walls, fire partitions and floors which are not on grade, seal the annular space between the pipe and sleeve with fire-stopping material and sealant that meet the requirement of Section 07 84 00 FIRESTOPPING.

3.8 PIPES PENETRATING WATERPROOFING MEMBRANES

Install pipes penetrating waterproofing membranes as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.9 FIRE SEAL

Fire seal all penetrations of fire rated partitions, walls and floors in accordance with Section 07 84 00 FIRESTOPPING.

3.10 ESCUTCHEONS

Provide escutcheons for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.11 SPECIAL REQUIREMENTS

Provide drips, grading of the lines, freeze protection, and branch outlet locations as shown and conforming to the requirements of NFPA 54.

3.12 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.

3.13 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.

3.14 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.

3.15 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.

3.16 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.

3.17 GAS SERVICE INSTALLATION

Gas service line, service regulator and gas company meter must be provided by natural gas utility company. 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.

3.17.1 Service Line

Provide 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. Provide 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.

Where steel pipe is used as service line, install corrosion prevention coating 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.

Where plastic pipe is used as the service line, make joints in accordance with procedures qualified by test. Personnel joining plastic pipe must be qualified by making a satisfactory specimen joint that passes the required inspection and test listed in 49 CFR 192.285. Inspection must be made by inspectors qualified in evaluating joints made under the specific joining procedure, as required by 49 CFR 192.287.

3.17.2 Service Regulator

Provide 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.

3.17.3 Gas Meter

Provide 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.

3.18 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.

3.18.1 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.

3.18.2 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.

3.18.3 Purging

After testing is completed, and before connecting any appliances, fully purge all gas piping. 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.

3.18.4 Labor, Materials and Equipment

Furnish all labor, materials and equipment necessary for conducting the testing and purging.

3.19 PIPE COLOR CODE MARKING

Provide color code marking of piping as specified in Section 09 90 00 PAINTS AND COATINGS, conforming to ASME A13.1.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 21 23

HYDRONIC PUMPS

08/17

PART 1 GENERAL

- 1.1 RELATED REQUIREMENTS
- 1.2 REFERENCES
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Manufacturer Services
 - 1.4.2 Standard Products
 - 1.4.3 Conformance with Agency Requirements
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Selection Criteria
 - 2.1.2 System Coordination
 - 2.1.3 Safety Requirements
- 2.2 MATERIALS AND EQUIPMENT
 - 2.2.1 Nameplates
 - 2.2.2 Framed Instructions
 - 2.2.3 Pump Characteristic
 - 2.2.4 Pump Drivers
 - 2.2.5 Equipment Data
- 2.3 HYDRONIC PUMPS
 - 2.3.1 Base-Mounted, Flexible Coupled, End suction
 - 2.3.1.1 Casing
 - 2.3.1.2 Pump Shaft
 - 2.3.1.3 Bearing
 - 2.3.1.4 Seal Assembly
 - 2.3.1.5 Baseplate
 - 2.3.1.6 Coupler
 - 2.3.1.7 Impeller
 - 2.3.1.8 Motor
 - 2.3.2 Cooling Coil Condensate Pump Units
 - 2.3.2.1 Motor
- 2.4 ELECTRICAL WORK
- 2.5 ELECTRICAL EQUIPMENT
 - 2.5.1 Electric Motors
 - 2.5.2 Control Equipment
 - 2.5.3 Variable Speed Control
- 2.6 EQUIPMENT APPURTENANCES
 - 2.6.1 Attachments
 - 2.6.2 Equipment Guards
 - 2.6.3 Tools
- 2.7 FINISHES

2.8 FACTORY TESTS

PART 3 EXECUTION

3.1 EXAMINATION

3.2 INSTALLATION

3.2.1 Base Mounted, Long-Coupled Pumps

3.3 FIELD QUALITY CONTROL

3.4 FIELD PAINTING

3.4.1 Touch-up painting

3.4.2 Exposed Ferrous Surfaces

3.5 CLOSEOUT ACTIVITIES

3.5.1 Operation and Maintenance Manuals

3.5.2 Training

-- End of Section Table of Contents --

SECTION 23 21 23

HYDRONIC PUMPS

08/17

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

Equipment or systems specified in this section are part of the commissioning process. Refer to Section 01 91 00.15 10, TOTAL BUILDING COMMISSIONING for additional requirements.

1.2 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1 (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 2016) 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 (2018) International Green Construction Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

NEMA Z535.4 (2011; R 2017) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

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 2020) UL Standard for Safety Motor-Operated Water Pumps

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 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

System Coordination; G

SD-03 Product Data

Instructions; G

Equipment Data; G

Training Period; G

SD-06 Test Reports

Factory Tests; G

Field Quality Control; G

SD-07 Certificates

Manufacturer's Representative; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Training; G

1.4 QUALITY ASSURANCE

1.4.1 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.

1.4.2 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 and motors of the same types must each be the product of one manufacturer.

1.4.3 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.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect equipment, delivered and designated for storage, from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.6 WARRANTY

Provide equipment with manufacturer's standard 2 year parts and labor warranty.

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.

Unless otherwise indicated and scheduled on drawings, provide equipment motor selections that do not exceed 1,800 rpm

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 Operation 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, pumps as scheduled designed for HVAC service in the following configurations:

Configuration	Pump No.
Base-Mounted, Flexible Coupled, End Suction	HHWP-1,2
Automatic Cooling Coil Condensate Pump Units	At Various ACs

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 250 psig working pressure with integral cast iron flanges drilled for ASME B16.1 ANSI Class 250 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. 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.

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 and be non-overloading at shutoff head. Provide squirrel-cage induction 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 for scheduled volts, 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. 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 8 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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 23 00

REFRIGERANT PIPING

08/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY ASSURANCE
 - 1.3.1 Qualifications
 - 1.3.2 Contract Drawings
- 1.4 DELIVERY, STORAGE, AND HANDLING
- 1.5 MAINTENANCE
 - 1.5.1 General
 - 1.5.2 Extra Materials

PART 2 PRODUCTS

- 2.1 STANDARD COMMERCIAL PRODUCTS
- 2.2 ELECTRICAL WORK
- 2.3 REFRIGERANT PIPING SYSTEM
- 2.4 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)
 - 2.4.1 Copper Tubing
 - 2.4.2 Brazing Filler Metal
 - 2.4.3 Brazing Flux
 - 2.4.4 Press Fittings
- 2.5 VALVES
 - 2.5.1 Refrigerant Stop Valves
 - 2.5.2 Check Valves
 - 2.5.3 Liquid Solenoid Valves
 - 2.5.4 Expansion Valves
 - 2.5.5 Electronic Expansion Valves
 - 2.5.6 Safety Relief Valves
 - 2.5.7 Evaporator Pressure Regulators, Direct-Acting
 - 2.5.8 Refrigerant Access Valves
- 2.6 PIPING ACCESSORIES
 - 2.6.1 Filter Driers
 - 2.6.2 Sight Glass and Liquid Level Indicator
 - 2.6.2.1 Assembly and Components
 - 2.6.2.2 Gauge Glass
 - 2.6.2.3 Bull's-Eye and Inline Sight Glass Reflex Lens
 - 2.6.2.4 Moisture Indicator
 - 2.6.3 Vibration Dampeners
 - 2.6.4 Flexible Pipe Connectors
 - 2.6.5 Strainers
 - 2.6.6 Pressure and Vacuum Gauges
 - 2.6.7 Temperature Gauges
 - 2.6.7.1 Stem Cased-Glass
 - 2.6.7.2 Bimetallic Dial
 - 2.6.7.3 Liquid-, Solid-, and Vapor-Filled Dial

- 2.6.7.4 Thermowell
- 2.6.8 Pipe Hangers, Inserts, and Supports
- 2.6.9 Escutcheons
- 2.7 FABRICATION
 - 2.7.1 Factory Coating
 - 2.7.2 Factory Applied Insulation

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
 - 3.2.1 Directional Changes
 - 3.2.2 Functional Requirements
 - 3.2.3 Fittings and End Connections
 - 3.2.3.1 Brazed Connections
 - 3.2.3.2 Flared Connections
 - 3.2.4 Valves
 - 3.2.4.1 General
 - 3.2.4.2 Expansion Valves
 - 3.2.4.3 Valve Identification
 - 3.2.5 Vibration Dampers
 - 3.2.6 Strainers
 - 3.2.7 Filter Dryer
 - 3.2.8 Sight Glass
 - 3.2.9 Discharge Line Oil Separator
 - 3.2.10 Accumulator
 - 3.2.11 Flexible Pipe Connectors
 - 3.2.12 Temperature Gauges
 - 3.2.13 Pipe Hangers, Inserts, and Supports
 - 3.2.13.1 Hangers
 - 3.2.13.2 Inserts
 - 3.2.13.3 C-Clamps
 - 3.2.13.4 Angle Attachments
 - 3.2.13.5 Saddles and Shields
 - 3.2.13.6 Horizontal Pipe Supports
 - 3.2.13.7 Vertical Pipe Supports
 - 3.2.13.8 Pipe Guides
 - 3.2.13.9 Steel Slides
 - 3.2.13.10 High Temperature Guides with Cradles
 - 3.2.13.11 Multiple Pipe Runs
 - 3.2.13.12 Bracing Requirements
 - 3.2.13.13 Structural Attachments
 - 3.2.14 Pipe Alignment Guides
 - 3.2.15 Pipe Anchors
 - 3.2.16 Building Surface Penetrations
 - 3.2.16.1 General Service Areas
 - 3.2.16.2 Waterproof Penetrations
 - 3.2.16.2.1 Waterproofing Clamping Flange
 - 3.2.16.2.2 Modular Mechanical Type Sealing Assembly
 - 3.2.16.3 Fire-Rated Penetrations
 - 3.2.16.4 Escutcheons
 - 3.2.17 Access Panels
 - 3.2.18 Field Applied Insulation
 - 3.2.19 Field Painting
 - 3.2.19.1 Color Coding
 - 3.2.19.2 Color Coding Scheme
 - 3.2.20 Identification Tags
- 3.3 CLEANING AND ADJUSTING
- 3.4 TRAINING COURSE

3.5 REFRIGERANT PIPING TESTS

- 3.5.1 Preliminary Procedures
- 3.5.2 Pneumatic Test
- 3.5.3 Evacuation Test
- 3.5.4 System Charging and Startup Test
- 3.5.5 Refrigerant Leakage
- 3.5.6 Contractor's Responsibility

-- End of Section Table of Contents --

SECTION 23 23 00

REFRIGERANT PIPING

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.

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 1-4 2020; Interpretation 5-8 2021; Addenda AS-CB 2022) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy

Fittings for Flared Copper Tubes

ASME B31.1	(2020) Power Piping
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	(2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM 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 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 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

Refrigerant Piping System; G

SD-03 Product Data

Refrigerant Piping System; G

Spare Parts; G

Qualifications; G

Refrigerant Piping Tests; G

Verification of Dimensions

SD-06 Test Reports

Refrigerant Piping Tests; G

SD-07 Certificates

Service Organization

SD-10 Operation and Maintenance Data

Maintenance; G

Operation and Maintenance Manuals; G

Demonstrations; G

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. Piping must be brazed in accordance with the qualified procedures using performance qualified brazing operators. Structural members and supports must be welded in accordance with the qualified procedures using performance qualified welders and welding operators. Procedures, brazers and welders must be qualified in accordance with ASME BPVC SEC IX. Welding and brazing 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 brazing operator must apply the personally assigned symbol near each joint made, as a permanent record. Structural members must be welded in accordance with Section 05 12 00 STRUCTURAL STEEL

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 ELECTRICAL WORK

Electrical equipment and wiring must be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Field wiring must be in accordance with manufacturer's instructions. 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.

2.3 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.

2.4 PIPE, FITTINGS AND END CONNECTIONS (JOINTS)

2.4.1 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 inch and 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.

2.4.2 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.

2.4.3 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.

2.4.4 Press Fittings

Press fittings are not acceptable for use in refrigerant piping systems.

2.5 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 connections. Valves larger than 1 inch must have brazed 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.

2.5.1 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 wrench operator and a seal cap. Valve must be the straight or angle pattern design as indicated.

2.5.2 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.

2.5.3 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.

2.5.4 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 indicated or for constant evaporator loads.

2.5.5 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.

2.5.6 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.

2.5.7 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.

2.5.8 Refrigerant Access Valves

Provide refrigerant access valves and hose connections in accordance with AHRI 720.

2.6 PIPING ACCESSORIES

2.6.1 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. Construct filter driers so that none of the desiccant will pass into the refrigerant lines. Minimum bursting pressure must be 1,500 psi.

2.6.2 Sight Glass and Liquid Level Indicator

2.6.2.1 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.

2.6.2.2 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.

2.6.2.3 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 backlighting viewing.

2.6.2.4 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.

2.6.3 Vibration Dampeners

Dampeners must be of the all-metallic bellows and woven-wire type.

2.6.4 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 at 300 degrees F. Unless otherwise indicated, the length of a flexible connector must be as recommended by the manufacturer for the service intended.

2.6.5 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.

2.6.6 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.

2.6.7 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.

2.6.7.1 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.

2.6.7.2 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.

2.6.7.3 Liquid-, Solid-, and Vapor-Filled Dial

Provide liquid-, solid-, and vapor-filled dial type cases that are greater than 3-1/2 inches, stainless steel or cast aluminum with clear acrylic lens. Fill must be nonmercury, suitable for encountered cross-ambients, and connecting capillary tubing must be double-braided bronze.

2.6.7.4 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.

2.6.8 Pipe Hangers, Inserts, and Supports

Provide pipe hangers, inserts, guides, and supports conforming to MSS SP-58.

2.6.9 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.

2.7 FABRICATION

2.7.1 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.

2.7.2 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 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.

3.2.3.2 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 the 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 downstream 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 the liquid line leaving a receiver 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, use a 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 Bracing Requirements

Support and brace piping and attached valves to resist seismic loads as specified under UFC 3-301-01 and Section 23 05 48.19 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 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 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.

3.2.16.2 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.

3.2.16.2.1 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.

3.2.16.2.2 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.

3.2.16.3 Fire-Rated Penetrations

Seal penetration of fire-rated walls, partitions, and floors as specified in Section 07 84 00 FIRESTOPPING.

3.2.16.4 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.

3.2.19.2 Color Coding Scheme

Provide a color coding scheme for locating hidden piping in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

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 least 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 immediately isolated 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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 25 00

CHEMICAL TREATMENT OF WATER FOR MECHANICAL SYSTEMS PACKAGE GLYCOL FEEDER

05/21

PART 1 GENERAL

- 1.1 RELATED REQUIREMENTS
- 1.2 REFERENCES
- 1.3 SUBMITTALS
- 1.4 MAINTENANCE MATERIAL SUBMITTALS
- 1.5 QUALITY CONTROL
 - 1.5.1 Safety
 - 1.5.2 Drawings
- 1.6 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

- 2.1 WATER TREATMENT SYSTEM PACKAGE GLYCOL FEEDER DESCRIPTION
 - 2.1.1 Summary
 - 2.1.2 Standard Products
 - 2.1.3 Water Analysis
- 2.2 EQUIPMENT
 - 2.2.1 Nameplates
 - 2.2.2 Electrical Work
 - 2.2.3 Gauges
- 2.3 COMPONENTS
 - 2.3.1 Low Temperature Hot Water Boilers
 - 2.3.1.1 Chemical Feeder
 - 2.3.1.2 Low and Medium Temperature Hot Water Treatment
 - 2.3.1.3 Test Kit Requirements
 - 2.3.2 Test Kit
 - 2.3.3 Supplemental Components/Services

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
 - 3.2.1 Piping
- 3.3 FIELD QUALITY CONTROL
 - 3.3.1 Tests
 - 3.3.2 Hot Water Boiler Water Quality Testing
 - 3.3.2.1 Low and Medium Temperature Systems (monthly)
 - 3.3.3 Quality Assurance Testing
 - 3.3.3.1 Hot Water Boiler Water Quality Assurance Testing
 - 3.3.4 Corrosion Testers
- 3.4 CLOSEOUT ACTIVITIES
 - 3.4.1 Training Course
- 3.5 INSPECTIONS
 - 3.5.1 Inspection General Requirements
 - 3.5.2 Boiler/Piping Test

-- End of Section Table of Contents --

SECTION 23 25 00

CHEMICAL TREATMENT OF WATER FOR MECHANICAL SYSTEMS PACKAGE GLYCOL FEEDER
05/21

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

Equipment or systems specified in this section are part of the commissioning process. Refer to Section 01 91 00.15 10, TOTAL BUILDING COMMISSIONING for additional requirements.

Refer to Section 23 52 00, HEATING BOILERS, TERMINAL HEATING UNITS AND GLYOL FEEDER for additional packaged glycol feeder requirements.

1.2 REFERENCES

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B40.100 (2013) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM D596 (2001; R 2018) Standard Guide for Reporting Results of Analysis of Water

ASTM D2688 (2015; E 2016) Standard Test Method for Corrosivity of Water in the Absence of Heat Transfer (Weight Loss Methods)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

1.3 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-03 Product Data

Water Treatment System Package Glycol Feeder; G, AE

Water Analysis; G, AE

Spare Parts

Field Instructions

Tests; G, AE

Training Course; G

SD-10 Operation and Maintenance Data

Water Treatment System Package Glycol Feeder; G

1.4 MAINTENANCE MATERIAL SUBMITTALS

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings, not later than 1 month prior to the date of beneficial occupancy. Include a complete list of parts and supplies, with source of supply, with the data.

1.5 QUALITY CONTROL

1.5.1 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. Provide ladder, and guardrail where indicated and in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS .

1.5.2 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.

1.6 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 WATER TREATMENT SYSTEM PACKAGE GLYCOL FEEDER 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 including packaged glycol feeder system(s). Provide and install the system with all necessary System Components, Accessories, Piping Components, and Supplemental Components/Services.

2.1.2 Standard Products

- a. Provide materials and equipment which are standard products of a

manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for two years' prior to bid opening.

- b. Include in the two-year use all applications of equipment and materials under similar circumstances and of similar size. Ensure the two years' experience has been satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a two-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown.
- c. All products are required to be supported by a service organization. Submit a certified list of qualified permanent service organizations for support of the equipment, including their addresses and qualifications. These service organizations are required to be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.
- 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 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 condenser and cooling tower. Acid treatment chemicals are not allowed to be used.

2.1.1.3 Water Analysis

Conditions of make-up water to be supplied to the boilers and hot water systems reported in accordance with ASTM D596 with the following information at a minimum:

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)
- d. Package Glycol Feeder System(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 4 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 Temperature Hot Water Boilers

Low temperature hot water boilers are defined as those operating below 250 degrees F.

2.3.1.1 Chemical Feeder

Provide a 5 gallon shot package glycol feeder system for the the hot water system as indicated and scheduled. 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.

Provide vertical packaged glycol feeder system with integral heavy duty polyethylene self supporting tank. Provide integral diaphragm type pumps with n+1 redundancy. Provide line size isolation ball valves on connections. Provide integral automatic air vent. Provide system pressure relief valve for installation in system piping.

2.3.1.2 Low and Medium Temperature Hot Water Treatment

Treat hot water with either a borax/nitrite type treatment or a molybdate type treatment. Both types of treatment are acceptable to use with glycol. Maintain borax/nitrite treatment at the limits of 600 to 1000 ppm nitrite, 40 - 50 ppm copper corrosion inhibitor (TT or MBT) and pH of 8.5 to 9.5. Maintain molybdate treatment at the limits of 100 to 125 ppm molybdate, 40 - 50 ppm copper corrosion inhibitor (TT or MBT) and pH of 8.0 to 9.0.

2.3.1.3 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 Test Kit

Provide one test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals (e.g. pH, hardness and sulfite).

2.3.3 Supplemental Components/Services

Ensure drain and makeup water piping complies with the requirements of Section 22 00 00 PLUMBING, GENERAL PURPOSE. Connect drains to sanitary sewer systems by means of an indirect waste connection.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy, before performing any work.

3.2 INSTALLATION

Provide all chemicals, equipment and labor necessary to bring all system waters in conformance with the specified requirements. Perform all work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.2.1 Piping

Fabricate all connections between dissimilar metals using dielectric unions.

3.3 FIELD QUALITY CONTROL

3.3.1 Tests

If the waters of the mechanical systems are not in conformance with the specified requirements or in accordance with manufacturer's recommendations, the contractor is required to direct the water treatment company to take corrective action to achieve compliance. Perform daily operational tests in the directed frequencies to maintain required control to prevent corrosion, scaling and damage to equipment during operation. Submit test schedules, at least 2 weeks prior to the start of related testing, for the condenser/chilled/boiler/condensate/feedwater water quality tests. Identify the date, time, frequency and collection location for each test within the schedules.

3.3.2 Hot Water Boiler Water Quality Testing

3.3.2.1 Low and Medium Temperature Systems (monthly)

Complete and record monthly testing for the following parameters.

pH	
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 (Na ₂ SO ₃)	ppm (mg/L)
Hardness(as CaCO ₃)	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
Condensate

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 8 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. Submit field instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. Include within the condensed operation instructions all preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. Frame the posted instructions under glass or laminated plastic and post where indicated by the Contracting Officer. Ensure the field instructions cover all of the items

contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations.

3.5 INSPECTIONS

3.5.1 Inspection General Requirements

Thirty days after project completion, inspect the cooling tower and condenser for problems due to corrosion, scale, and biological growth. If the cooling tower and condenser are found not to conform to the manufacturer's recommended conditions, and the water treatment company recommendations have been followed; instruct the water treatment company to provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

3.5.2 Boiler/Piping Test

Thirty days after project completion, inspect the boiler and condensate piping for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water treatment company recommendations have been followed, instruct the water treatment company to provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations. If corrosion is found within the condensate piping, proper repairs are required to be made by the water treatment company at no additional cost.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 30 00

HVAC AIR DISTRIBUTION

05/20

PART 1 GENERAL

- 1.1 RELATED REQUIREMENTS
- 1.2 REFERENCES
- 1.3 SYSTEM DESCRIPTION
 - 1.3.1 Mechanical Equipment Identification
 - 1.3.1.1 Charts
 - 1.3.1.2 Diagrams
 - 1.3.2 Service Labeling
 - 1.3.3 Color Coding
- 1.4 SUBMITTALS
- 1.5 Certifications
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Prevention of Corrosion
 - 1.6.2 Asbestos Prohibition
 - 1.6.3 Ozone Depleting Substances Technician Certification
 - 1.6.4 Detail Drawings
 - 1.6.5 Test Procedures
- 1.7 DELIVERY, STORAGE, AND HANDLING
- 1.8 ACCESSIBILITY OF EQUIPMENT
- 1.9 WARRANTY

PART 2 PRODUCTS

- 2.1 STANDARD PRODUCTS
- 2.2 IDENTIFICATION PLATES
- 2.3 EQUIPMENT GUARDS AND ACCESS
- 2.4 ELECTRICAL WORK
- 2.5 ANCHOR BOLTS
- 2.6 PAINTING
- 2.7 INDOOR AIR QUALITY
- 2.8 DUCT SYSTEMS
 - 2.8.1 Metal Ductwork
 - 2.8.1.1 Insulated Nonmetallic Flexible Duct Runouts
 - 2.8.1.2 General Service Duct Connectors
 - 2.8.1.3 Aluminum Ducts
 - 2.8.1.4 Copper Sheets
 - 2.8.1.5 Corrosion Resisting (Stainless) Steel Sheets
 - 2.8.2 Duct Access Doors
 - 2.8.3 Fire Dampers
 - 2.8.4 Manual Balancing Dampers
 - 2.8.5 Air Supply And Exhaust Air Dampers
 - 2.8.6 Sound Attenuation Equipment
 - 2.8.6.1 Systems with total pressure above 4 Inches Water Gauge
 - 2.8.6.2 System with total pressure of 4 Inch Water Gauge and Lower
 - 2.8.7 Diffusers, Registers, and Grilles

- 2.8.7.1 Diffusers
- 2.8.7.2 Registers and Grilles
- 2.8.8 Louvers
- 2.8.9 Air Vents and Goosenecks
- 2.8.10 Bird Screens and Frames
- 2.9 AIR SYSTEMS EQUIPMENT
 - 2.9.1 Fans
 - 2.9.1.1 Centrifugal Fans
 - 2.9.1.2 In-Line Centrifugal Fans
 - 2.9.2 Coils
 - 2.9.2.1 Direct-Expansion Coils
 - 2.9.2.2 Water Coils
 - 2.9.3 Air Filters
 - 2.9.3.1 Extended Surface Pleated Panel Filters
 - 2.9.3.2 Cartridge Type Filters
 - 2.9.3.3 Holding Frames
 - 2.9.3.4 Filter Gauges
- 2.10 AIR HANDLING UNITS
 - 2.10.1 Factory-Fabricated Air Handling Units
 - 2.10.1.1 Casings
 - 2.10.1.2 Heating and Cooling Coils
 - 2.10.1.3 Air Filters
 - 2.10.1.4 Fans
 - 2.10.1.5 Access Sections and Filter/Mixing Boxes
- 2.11 TERMINAL UNITS
 - 2.11.1 Variable Air Volume (VAV) Terminal Units
 - 2.11.1.1 Variable Volume, Single Duct Terminal Units
 - 2.11.1.2 Reheat Units
 - 2.11.1.2.1 Hot Water Coils
- 2.12 ENERGY RECOVERY DEVICES
 - 2.12.1 Rotary Wheel
- 2.13 FACTORY PAINTING
- 2.14 SUPPLEMENTAL COMPONENTS/SERVICES
 - 2.14.1 Hot Water Piping
 - 2.14.2 Refrigerant Piping
 - 2.14.3 Water Heating System Accessories
 - 2.14.4 Condensate Drain Lines
 - 2.14.5 Insulation
- 2.15 OZONE DEPLETING SUBSTANCES

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
 - 3.2.1 Condensate Drain Lines
 - 3.2.2 Equipment and Installation
 - 3.2.3 Access Panels
 - 3.2.4 Flexible Duct
 - 3.2.5 Metal Ductwork
 - 3.2.6 Dust Control
 - 3.2.7 Insulation
 - 3.2.8 Duct Test Holes
 - 3.2.9 Power Transmission Components Adjustment
- 3.3 ROOF CURBS AND SUPPORTS
- 3.4 CUTTING AND PATCHING
- 3.5 CLEANING
- 3.6 PENETRATIONS
 - 3.6.1 Sleeves
 - 3.6.2 Framed Prepared Openings

- 3.6.3 Insulation
 - 3.6.4 Closure Collars
 - 3.6.5 Firestopping
 - 3.7 FIELD PAINTING OF MECHANICAL EQUIPMENT
 - 3.7.1 Temperatures less than 120 degrees F
 - 3.7.2 Temperatures between 120 and 400 degrees F
 - 3.7.3 Temperatures greater than 400 degrees F
 - 3.7.4 Finish Painting
 - 3.7.5 Color Coding Scheme for Locating Hidden Utility Components
 - 3.8 IDENTIFICATION SYSTEMS
 - 3.9 DUCTWORK LEAK TEST
 - 3.10 DAMPER ACCEPTANCE TEST
 - 3.11 TESTING, ADJUSTING, AND BALANCING
 - 3.12 PERFORMANCE TESTS
 - 3.13 CLEANING AND ADJUSTING
 - 3.14 OPERATION AND MAINTENANCE
 - 3.14.1 Operation and Maintenance Manuals
 - 3.14.2 Operation And Maintenance Training
- End of Section Table of Contents --

SECTION 23 30 00

HVAC AIR DISTRIBUTION
05/20

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

Equipment or systems specified in this section are part of the commissioning process. Refer to Section 01 91 00.15 10, TOTAL BUILDING COMMISSIONING for additional requirements.

1.2 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 201	(2002; R 2011) Fans and Systems
AMCA 210	(2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 300	(2014) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(2014) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	(2018) Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 260 I-P	(2012) Sound Rating of Ducted Air Moving and Conditioning Equipment
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	(2017) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62.1	(2010) Ventilation for Acceptable Indoor Air Quality
ASHRAE 68	(1997) Laboratory Method of Testing to Determine the Sound Power In a Duct
ASHRAE 70	(2006; R 2011) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 84	(2020) Method of Testing Air-to-Air Heat Exchangers
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 1-4 2020; Interpretation 5-8 2021; Addenda AS-CB 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 A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by

the Hot-Dip Process

ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B152/B152M	(2019) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM 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	(2020) Standard Specification for Industrial Woven Wire Cloth

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers
--------------------	--

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators
NEMA MG 10	(2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors

NEMA MG 11 (1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2021) Standard for the Installation of Air Conditioning and Ventilating Systems

NFPA 701 (2019) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1819 (2002) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, 5th Edition

SMACNA 1966 (2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition

SMACNA 1972 CD (2012) HVAC Air Duct Leakage Test Manual - 2nd Edition

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168 (2017) Adhesive and Sealant Applications

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82 Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 6 (2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel

UL 181 (2013; Reprint Apr 2017) UL Standard for Safety Factory-Made Air Ducts and Air Connectors

UL 555 (2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers

UL 586 (2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units

UL 705 (2017; Reprint Oct 2018) UL Standard for Safety Power Ventilators

UL 900 (2015) Standard for Air Filter Units

UL 1995 (2015) UL Standard for Safety Heating and Cooling Equipment

UL Bld Mat Dir (updated continuously online) Building Materials Directory

UL Electrical Construction (2012) Electrical Construction Equipment Directory

UL Fire Resistance (2014) Fire Resistance Directory

1.3 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.

1.3.1 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.

1.3.1.1 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.

1.3.1.2 Diagrams

Submit proposed diagrams, at least 2 weeks prior to start of related testing. provide neat mechanical drawings provided with extruded aluminum frame under 1/8-inch glass or laminated plastic, system diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system. After approval, post these items where directed.

1.3.2 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 equipment designations in the contract documents. 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 -

SERVICE	LABEL AND TAG DESIGNATION
Fan Coil Unit Number	FC -
Terminal Box Number	TB -
Unit Ventilator Number	UV -

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

1.3.3 Color Coding

Color coding of all piping systems must be in accordance with ASME A13.1 .

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.. 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

Detail Drawings; G, AE

SD-03 Product Data

Insulated Nonmetallic Flexible Duct Runouts; G

Duct Connectors

Duct Access Doors; G

Fire Dampers; G

Manual Balancing Dampers; G

Sound Attenuation Equipment; G, AE

Diffusers; G

Registers and Grilles; G

Louvers; G

Air Vents and Goosenecks; G

Ozone Depleting Substances; S

Centrifugal Fans; G, AE

In-Line Centrifugal Fans; G, AE

Variable Volume, Single Duct Terminal Units; G, AE

Reheat Units; G

Air Handling Units; G, AE

Energy Recovery Devices; G

Test Procedures

Diagrams; G

Indoor Air Quality for Duct Sealants; S

Indoor Air Quality for Filter Media; S

SD-06 Test Reports

Performance Tests; G

Damper Acceptance Test; G

SD-07 Certificates

Bolts

Ozone Depleting Substances Technician Certification

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions; G

Operation and Maintenance Training; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Fire Dampers; G

Manual Balancing Dampers; G

Centrifugal Fans; G

In-Line Centrifugal Fans; G

Air Handling Units; G

Variable Volume, Single Duct Terminal Units; G

Energy Recovery Devices; G

Reheat Units; G

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

1.5 Certifications

For compliance with sustainability requirements, provide adhesives and sealants applied within the building interior with VOC emissions certified in compliance with California Department of Public Health CDPH SECTION 01350 Standard Method and VOC content in compliance with limits of SCAQMD Rule 1168.

1.6 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>.

1.6.1 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.

1.6.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.6.3 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.

1.6.4 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. Submit schematic control diagram showing equipment configuration, sequence of operation, control and field devices, power connection and control wiring.

1.6.5 Test Procedures

Conduct performance tests as required in Section 23 05 93 Testing, Adjusting and Balancing for HVAC.

1.7 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

1.8 ACCESSIBILITY OF EQUIPMENT

The following requirement is intended to solicit the installer's help in the prudent location of equipment when he has some control over locations. However, designer's should not rely on it at all since enforcing this requirement in the field would be difficult. Therefore, the system designer needs to layout and indicate the locations of equipment, control devices, and access doors so that most of the accessibility questions are resolved inexpensively during design.

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.

1.9 WARRANTY

Provide equipment with manufacturer's standard minimum 1 year parts and labor warranty. Provide equipment compressors with 5 year parts and labor warranty, and an additional 5 years parts only (10 years total time period) warranty.

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.

Unless otherwise indicated or scheduled on drawings, provide equipment motor selections that do not exceed 1,800 rpm.

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.

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 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.
- b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide premium efficiency type integral size motors in accordance with NEMA MG 1.
- c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.
- d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.
- e. Provide variable frequency drives for motors as specified.

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 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's

standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.7 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

Provide Indoor Air Quality for Filter Media.

2.8 DUCT SYSTEMS

2.8.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

- a. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.
- b. Provide ductwork that meets the requirements of Seal Class A. Provide ductwork in VAV systems upstream of the VAV boxes that meets the requirements of Seal Class A.
- c. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant. Provide duct sealant products that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants are classified as "Other" within the SCAQMD Rule 1168 sealants table). Provide validation of indoor air quality for duct sealants.
- d. Make spiral lock seam duct, with duct sealant and lock with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable.
- e. Provide double wall insulated ducts for ductwork located outside of the building. Construct outer duct of stainless steel or aluminum and solid inner duct with G90 galvanized steel. Provide minimum 2-inch thick mineral fiber insulation with minimum R-value of 7.1 ft² x hr x F/BTU. Completely seal exterior ducts to prevent water intrusion into the duct.
- f. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

2.8.1.1 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.8.1.2 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

2.8.1.3 Aluminum Ducts

ASTM B209, alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and bar stock.

2.8.1.4 Copper Sheets

ASTM B152/B152M, light cold rolled temper.

2.8.1.5 Corrosion Resisting (Stainless) Steel Sheets

ASTM A167, Type 316

2.8.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.8.3 Fire Dampers

Use 1.5 hour rated fire dampers unless otherwise indicated. Provide fire dampers that conform to the requirements of NFPA 90A and UL 555. Perform the fire damper test as outlined in NFPA 90A. Provide a pressure relief

door upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then provide a factory installed pressure relief damper. Provide automatic operating fire dampers with a dynamic rating suitable for the maximum air velocity and pressure differential to which it is subjected. Provide fire dampers approved for the specific application, and install according to their listing. Equip fire dampers with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, does not impair the operation of the damper. Equip sleeves or frames with perimeter mounting angles attached on both sides of the wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies in conformance with UL Fire Resistance. Provide curtain type with damper blades out of the air stream multi-blade type 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.

2.8.4 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.

2.8.5 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:

The maximum damper leakage at 1.0 inch w.g. is 3 cfm per square foot for motorized dampers and for non-motorized dampers is 20 cfm per square foot of damper area.

Dampers smaller than 24 inches in either direction may have leakage of 40 cfm per square foot.

2.8.6 Sound Attenuation Equipment

2.8.6.1 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.

2.8.6.2 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 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.

2.8.7 Diffusers, Registers, and Grilles

Provide factory-fabricated units of steel or aluminum as indicated on the drawings 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.

2.8.7.1 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.

2.8.7.2 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.

2.8.8 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 AND DOOR LOUVERS.

2.8.9 Air Vents and Goosenecks

Fabricate air vents and goosenecks from galvanized steel sheets with galvanized structural shapes. Provide sheet metal thickness, reinforcement, and fabrication that conform to SMACNA 1966. Accurately fit and secure louver blades to frames. Fold or bead edges of louver blades for rigidity and baffle these edges to exclude driving rain. Provide air vents and goosenecks with bird screen.

2.8.10 Bird Screens and Frames

Provide bird screens that conform to ASTM E2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames

fabricated from either stainless steel or extruded aluminum.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans must not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 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.

2.9.1.1 Centrifugal Fans

Provide fully enclosed, single-width single-inlet, or double-width double-inlet centrifugal fans, with AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Provide impeller wheels that are rigidly constructed and accurately balanced both statically and dynamically. Provide forward curved or backward-inclined airfoil design fan blades in wheel sizes up to 30 inches. Provide backward-inclined airfoil design fan blades for wheels over 30 inches in diameter. Provide fan wheels over 36 inches in diameter with overhung pulleys and a bearing on each side of the wheel. Provide fan wheels 36 inches or less in diameter that have one or more extra long bearings between the fan wheel and the drive. Provide sleeve type, self-aligning and self-oiling bearings with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Connect grease fittings to tubing for serviceability from a single accessible point. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide steel, accurately finished fan shafts, with key seats and keys for impeller hubs and fan pulleys. Provide fan outlets of ample proportions, designed for the attachment of angles and bolts for attaching flexible connections. Unless otherwise indicated, provide motors that do not exceed 1800 rpm and

have open dripproof enclosures. Provide magnetic reduced-voltage-start type motor starters with watertight enclosure.

2.9.1.2 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. Provide motors with opendripproof enclosure. Provide manual motor starters across-the-line with general-purpose enclosures. Provide wall-mounted switch to activate and de-activate fan. Provide remote manual switch with pilot indicating light where indicated.

2.9.2 Coils

Provide fin-and-tube type coils constructed of seamless copper tubes and aluminum or copper fins mechanically bonded or soldered to the tubes. Provide copper tube wall thickness that is a minimum of 0.020 inches.. Coils must be sized for a maximum air velocity to not exceed 500 feet per minute. Provide aluminum fins that are 0.0055 inch minimum thickness. Provide copper fins that are 0.0045 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. Provide factory applied phenolic, vinyl or epoxy/electrodeposition coating.

2.9.2.1 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.

2.9.2.2 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.

2.9.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

2.9.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters 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.

2.9.3.2 Cartridge Type Filters

Provide 12 inch depth, sectional, replaceable dry media type filters of the size indicated with a MERV of 13 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.56 inches, water gauge. Provide UL class 1 filters, and pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face velocity or turbulent airflow have no effect on filter integrity or performance. Install each filter in a factory preassembled side access housing, or a factory-made sectional frame bank, as indicated.

2.9.3.3 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.

2.9.3.4 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 taps 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.

2.10 AIR HANDLING UNITS

2.10.1 Factory-Fabricated Air Handling Units

Provide multizone draw-through type units as indicated. Units must include fans, coils, airtight insulated casing, prefilters, secondary filter sections, adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, mixing box combination sectional filter-mixing box, dry steam dispersion type humidifier, vibration-isolators, and appurtenances required for specified operation. Air handling units must include energy recovery section with exhaust air

fan. Provide vibration isolators as indicated. Provide energy recovery as indicated and as specified in paragraph ENERGY RECOVERY DEVICES. Units located outside must be custom construction with a full-height service vestibule. This service vestibule must be sized to house all unit components (valves, pumps, etc.) and electronics (variable speed drives, control panels, etc.). Proper clearance must be provided to meet the equipment manufacturer's recommendations and the National Electric Code. 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.

2.10.1.1 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. Inner casing of double-wall units that are a minimum 20 gauge solid galvanized steel or 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. Provide dual wall construction with integral thermal breaks with no thermal bridging utilizing minimum 2.0 inches thick 3.0 pounds per square foot high density injected foam insulation.
- 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. Install a minimum 8 by 8 inches sealed glass window suitable for the intended application, in all access doors.
- d. Double-wall insulated type drain pan (thickness equal to exterior casing utilizing 3.0 pounds per square foot high density injected foam insulation) 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 double-wall casing sections handling conditioned air with not less than 2 inches of utilizing 3.0 pounds per square foot high density injected foam insulation. Foil-faced insulation must not be used. Seal double wall insulation completely by inner and outer panels; provide integral thermal break construction.
- h. A latched and hinged inspection door, in the fan and coil sections. Provide inspection doors, access doors and access sections at all sections requiring routine maintenance, repairs access or cleaning.

2.10.1.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.10.1.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.10.1.4 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.
- c. Fans that are driven by a unit-mounted, or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Furnish belt guards that are the three-sided enclosed type with solid or expanded metal face. Design belt drives for not less than a 1.3 service factor based on motor nameplate rating.
- d. Motor sheaves that are variable pitch for 25 hp and below and fixed pitch above 25 hp as defined by AHRI Guideline D. Where fixed sheaves are required, the use of variable pitch sheaves is allowed during air balance, but replace them with an appropriate fixed sheave after air balance is completed. Select variable pitch sheaves to drive the fan at a speed that produces the specified capacity when set at the approximate midpoint of the sheave adjustment. Furnish motors for V-belt drives with adjustable bases, and with totally enclosed enclosures.
- e. Motor starters of magneticacross-the-line type with watertight

enclosure. Select unit fan or fans to produce the required capacity at the fan static pressure with sound power level as indicated. Obtain the sound power level values according to AMCA 300, ASHRAE 68, or AHRI 260 I-P.

2.10.1.5 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. Provide each damper with separate dedicated motorized electric actuators. Damper linkages for multiple dampers must not be used.

2.11 TERMINAL UNITS

2.11.1 Variable Air Volume (VAV) Terminal Units

- a. Provide VAV and dual duct 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.
- 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.

2.11.1.1 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Provide units with an internal resistance not exceeding 0.4 inch water gauge at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

2.11.1.2 Reheat Units

2.11.1.2.1 Hot Water Coils

Provide fin-and-tube type hot-water coils constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Provide headers that are constructed of cast iron, welded steel or copper. Provide casing and tube support sheets that are 16 gauge,

galvanized steel, formed to provide structural strength. Provide tubes that are correctly circuited for proper water velocity without excessive pressure drop and are drainable where required or indicated. At the factory, test each coil at not less than 250 psi air pressure and provide coils suitable for 200 psi working pressure. Install drainable coils in the air handling units with a pitch of not less than 1/8 inch per foot of tube length toward the drain end. Coils must conform to the provisions of AHRI 410.

2.12 ENERGY RECOVERY DEVICES

2.12.1 Rotary Wheel

Provide unit that is a factory fabricated and tested assembly for air-to-air energy recovery by transfer of sensible heat from exhaust air to supply air stream, with device performance according to ASHRAE 84 and that delivers an energy transfer effectiveness of not less than 80 percent with cross-contamination not in excess of 1.0 percent of exhaust airflow rate at system design differential pressure, including purging sector if provided with wheel. Provide exchange media that is chemically inert, moisture-resistant, fire-retardant, laminated, nonmetallic material which complies with NFPA 90A. Isolate exhaust and supply streams by seals which are static, field adjustable, and replaceable. Equip chain drive mechanisms with ratcheting torque limiter or slip-clutch protective device. Fabricate enclosure from galvanized steel and include provisions for maintenance access. Provide recovery control and rotation failure provisions as indicated.

2.13 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat both internal coils, internal surfaces and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM A653/A653M, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and with no exposure to outdoor air. Submit evidence of satisfactory paint performance for a minimum of 3,000 hours for units to be installed outdoors for all external and internal surfaces, including coils. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Field paint factory painting that has been damaged prior to acceptance by the Contracting Officer in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

2.14 SUPPLEMENTAL COMPONENTS/SERVICES

2.14.1 Hot Water Piping

The requirements for hot water piping and accessories are specified in Section 23 05 15 COMMON PIPING FOR HVAC.

2.14.2 Refrigerant Piping

The requirements for refrigerant piping are specified in Section 23 23 00 REFRIGERANT PIPING.

2.14.3 Water Heating System Accessories

The requirements for water heating accessories such as expansion tanks and steam traps are specified herein.

2.14.4 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate. Provide type L copper condensate drain piping with wrought copper fittings.

2.14.5 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.15 OZONE DEPLETING SUBSTANCES

Unitary air conditioning equipment must not use CFC-based refrigerants. Refrigerant shall 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.

HVAC systems must follow the regulations of Colorado Regulation 22: Manufacturers/sellers in the State of Colorado of air-conditioning, refrigeration, foam, or aerosol propellant products, must provide a written disclosure to the buyer as part of the sales transaction and invoice or a label on the product or equipment. Refer to <https://www.epa.gov/snap/substitutes-refrigeration-and-air-conditioning> for all prohibited refrigerants and substitutions.

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).

- 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.

Indoor equipment condensate drain lines must be routed to nearest utility sink or floor drain; refer to drawings. Rooftop mounted equipment condensate drain lines must be routed to nearest roof drain. All condensate drains must be routed in a manner that minimizes bends and any potential tripping hazards.

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.

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.

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.

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 ROOF CURBS AND SUPPORTS

Provide welded steel roof curbs constructed with minimum 14 gauge galvanized steel exterior panels and 18 gauge galvanized steel inner panels. Provide minimum 1-inch thick, 1.5 pound density thermal insulation. Coordinate required structural steel with indicated structural work.

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. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

3.6.1 Sleeves

Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A53/A53M, Schedule 20.

3.6.2 Framed Prepared Openings

Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

3.6.3 Insulation

Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 60 degrees F, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

3.6.4 Closure Collars

Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with

fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.6.5 Firestopping

Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING.

3.7 FIELD PAINTING OF MECHANICAL EQUIPMENT

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

3.7.1 Temperatures less than 120 degrees F

Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

3.7.2 Temperatures between 120 and 400 degrees F

Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

3.7.3 Temperatures greater than 400 degrees F

Apply two coats of 315 degrees C 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of two mils to metal surfaces subject to temperatures greater than 400 degrees F.

3.7.4 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.

3.7.5 Color Coding Scheme for Locating Hidden Utility Components

Use scheme in buildings having suspended grid ceilings. Provide color coding scheme that identifies points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid, consisting of a color code board and colored metal disks. Make each colored metal disk approximately 3/8 inch diameter and secure to removable ceiling panels with fasteners. Insert each fastener into the ceiling panel so as to be concealed from view. Provide fasteners that are manually removable without the use of tools and that do not separate from the ceiling panels

when the panels are dropped from ceiling height. Make installation of colored metal disks follow completion of the finished surface on which the disks are to be fastened. Provide color code board that is approximately 3 foot wide, 30 inches high, and 1/2 inches thick. Make the board of wood fiberboard and frame under glass or 1/16 inch transparent plastic cover. Make the color code symbols approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. Mount the color code board in the mechanical or equipment room. Make the color code system in accordance with facility practices and requirements.

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. Provide test procedure, apparatus, and report that conform to SMACNA 1972 CD. The maximum allowable leakage rate must be per the Duct Construction and Leakage Testing Table on design drawings. 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 40 hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 52 00

HEATING BOILERS, TERMINAL HEATING UNITS AND GLYCOL FEEDER

04/08, CHG 5: 11/19

PART 1 GENERAL

- 1.1 RELATED REQUIREMENTS
- 1.2 REFERENCES
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 EXTRA MATERIALS
- 1.7 WARRANTY

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
 - 2.1.1 Standard Products
 - 2.1.2 Asbestos Prohibition
 - 2.1.3 Nameplates
 - 2.1.4 Equipment Guards
- 2.2 CONDENSING BOILERS
 - 2.2.1 Condensing Boiler
 - 2.2.2 Packaged Factory Controls
 - 2.2.3 Modular Configuration
- 2.3 FUEL BURNING EQUIPMENT
 - 2.3.1 Burners
 - 2.3.1.1 Gas Fired Burners and Controls
 - 2.3.2 Draft Fans
 - 2.3.2.1 Draft Fan Control
 - 2.3.2.2 Draft Fan Drives
 - 2.3.3 Draft Damper
 - 2.3.4 Ductwork
- 2.4 COMBUSTION CONTROL EQUIPMENT
 - 2.4.1 Electrical controls
 - 2.4.2 Water Temperature Controller
 - 2.4.3 Boiler Plant Master Controller
 - 2.4.4 Boiler Combustion Controls and Positioners
 - 2.4.5 Combustion Safety Controls and Equipment
 - 2.4.5.1 Low-water Cutoff
 - 2.4.5.1.1 Pump Controller with Low-Water Cutoff
 - 2.4.5.1.2 Supplementary Low-Water Cutoff
 - 2.4.5.2 Water Flow Interlock
- 2.5 PUMPS
 - 2.5.1 Hot Water Circulating Pumps
- 2.6 COLD WATER CONNECTIONS
- 2.7 UNIT HEATERS
 - 2.7.1 Propeller Fan Unit Heaters
 - 2.7.2 Centrifugal Fan Cabinet Unit Heaters
 - 2.7.3 Heating Elements

- 2.7.4 Motors
- 2.7.5 Motor Switches
- 2.7.6 Controls
- 2.8 OUTDOOR AIR HANDLING UNITS
- 2.9 FITTINGS AND ACCESSORIES
 - 2.9.1 Direct Vents
 - 2.9.1.1 Combustion Air Intake Vent
 - 2.9.1.2 Exhaust Vent
 - 2.9.2 Expansion Tank
 - 2.9.3 Air Separator
 - 2.9.4 Filters
 - 2.9.5 Steel Sheets
 - 2.9.5.1 Galvanized Steel
 - 2.9.6 Gaskets
 - 2.9.7 Steel Pipe and Fittings
 - 2.9.8 Copper Tubing and Fittings
 - 2.9.9 Dielectric Flanges
 - 2.9.10 Flexible Pipe Connectors
 - 2.9.11 Pipe Supports
 - 2.9.12 Pipe Expansion
 - 2.9.12.1 Expansion Loops
 - 2.9.12.2 Expansion Joints
 - 2.9.13 Valves
 - 2.9.14 Strainers
 - 2.9.15 Pressure Gauges
 - 2.9.16 Thermometers
 - 2.9.17 Air Vents
 - 2.9.17.1 Manual Air Vents
 - 2.9.17.2 Automatic Air Vents
- 2.10 ELECTRICAL EQUIPMENT
 - 2.10.1 Motor Ratings
 - 2.10.2 Motor Controls
- 2.11 INSULATION
- 2.12 TOOLS
 - 2.12.1 Breeching Cleaner
 - 2.12.2 Wrenches
- 2.13 BOILER WATER TREATMENT
 - 2.13.1 Glycol Feed System
 - 2.13.1.1 Supply Tank and Stand
 - 2.13.1.2 Glycol Pump
 - 2.13.1.3 Pressure Switch
 - 2.13.1.4 Level Switch
 - 2.13.1.5 Control Panel

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 ERECTION OF BOILER AND AUXILIARY EQUIPMENT
- 3.3 PIPING INSTALLATION
 - 3.3.1 Hot Water Piping and Fittings
 - 3.3.2 Vent Piping and Fittings
 - 3.3.3 Gauge Piping
 - 3.3.4 Joints
 - 3.3.4.1 Threaded Joints
 - 3.3.4.2 Welded Joints
 - 3.3.4.3 Brazed Copper Pipe and Tubing
 - 3.3.5 Flanges and Unions
 - 3.3.6 Branch Connections
 - 3.3.6.1 Branch Connections for Hot Water Systems

- 3.3.7 Brazed, Copper Pipe and Tubing
- 3.3.8 Supports
 - 3.3.8.1 Pipe Hangers, Inserts, and Supports
 - 3.3.8.1.1 Types 5, 12, and 26
 - 3.3.8.1.2 Type 3
 - 3.3.8.1.3 Type 18
 - 3.3.8.1.4 Type 19 and 23 C-Clamps
 - 3.3.8.1.5 Type 20 Attachments
 - 3.3.8.1.6 Type 24
 - 3.3.8.1.7 Horizontal Pipe Supports
 - 3.3.8.1.8 Vertical Pipe Support
 - 3.3.8.1.9 Type 35 Guides
 - 3.3.8.1.10 Horizontal Insulated Pipe
 - 3.3.8.1.11 Structural Steel Attachments
 - 3.3.8.2 Multiple Pipe Runs
- 3.3.9 Anchors
- 3.3.10 Valves
- 3.3.11 Pipe Sleeves
 - 3.3.11.1 Pipes Passing Through Waterproofing Membranes
 - 3.3.11.2 Optional Modular Mechanical Sealing Assembly
 - 3.3.11.3 Optional Counterflashing
 - 3.3.11.4 Fire Seal
- 3.3.12 Balancing Valves
- 3.3.13 Thermometer Wells
- 3.3.14 Air Vents
- 3.3.15 Escutcheons
- 3.3.16 Drains
- 3.3.17 Strainer Blow-Down Piping
- 3.3.18 Direct Venting for Combustion Intake Air and Exhaust Air
- 3.4 NATURAL GAS FUEL SYSTEM
- 3.5 COLOR CODE MARKING AND FIELD PAINTING
- 3.6 MANUFACTURER'S SERVICES
- 3.7 TEST OF BACKFLOW PREVENTION ASSEMBLIES
- 3.8 HEATING SYSTEM TESTS
 - 3.8.1 Water Treatment Testing
 - 3.8.2 Boiler/Piping Test
- 3.9 CLEANING
 - 3.9.1 Boilers and Piping
 - 3.9.2 Heating Units
- 3.10 FIELD TRAINING
- 3.11 FUEL SYSTEM TESTS
 - 3.11.1 Gas System Test

-- End of Section Table of Contents --

SECTION 23 52 00

HEATING BOILERS, TERMINAL HEATING UNITS AND GLYCOL FEEDER
04/08, CHG 5: 11/19

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

Equipment or systems specified in this section are part of the commissioning process. Refer to Section 01 91 00.15 10, TOTAL BUILDING COMMISSIONING for additional requirements.

1.2 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 801 (2001; R 2008) Industrial Process/Power
Generation Fans: Specification Guidelines

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 52.2 (2017) Method of Testing General
Ventilation Air-Cleaning Devices for
Removal Efficiency by Particle Size

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.20 (2017) Metallic Gaskets for Pipe Flanges

ASME B31.1 (2020) Power Piping

ASME B31.5 (2020) Refrigeration Piping and Heat
Transfer Components

ASME BPVC SEC IV (2017) BPVC Section IV-Rules for
Construction of Heating Boilers

ASME BPVC SEC IX (2017; Errata 2018) BPVC Section
IX-Welding, Brazing and Fusing
Qualifications

ASME BPVC SEC VIII D1 (2019) BPVC Section VIII-Rules for
Construction of Pressure Vessels Division 1

ASME CSD-1 (2016) Control and Safety Devices for
Automatically Fired Boilers

AMERICAN WELDING SOCIETY (AWS)

AWS B2.2/B2.2M (2016) Specification for Brazing Procedure

and Performance Qualification

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 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
-----------	------------------------------------

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-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
-----------	--

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2021) National Fuel Gas Code
NFPA 85	(2019) Boiler and Combustion Systems Hazards Code

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)
-------------	---

UNDERWRITERS LABORATORIES (UL)

UL 795	(2016; Reprint Sep 2020) UL Standard for Safety Commercial-Industrial Gas Heating Equipment
--------	---

UL 1738	(2010; Reprint Feb 2020) Venting Systems for Gas-Burning Appliances, Categories II, III and IV
UL FLAMMABLE & COMBUSTIBLE	(2012) Flammable and Combustible Liquids and Gases Equipment Directory

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 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

Detail Drawings; G, AE

SD-03 Product Data

Materials and Equipment; G, AE

Energy Star label for gas fired hot water boiler product; S, AE

Spare Parts

Water Treatment System; G, AE

Boiler Water Treatment; G, AE

Packaged Glycol Feeder System; G, AE

Heating System Tests; G, AE

Fuel System Tests; G, AE

Unit Heaters; G, AE

Centrifugal Fan Cabinet Unit Heaters; G, AE

Welding

Qualifications; G

Field Instructions

Tests; G

SD-06 Test Reports

Heating System Tests; G, AE

Fuel System Tests; G, AE

Packaged Glycol Feeder System; G, AE

Water Treatment Testing; G, AE

SD-07 Certificates

Bolts; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Instructions; G

Packaged Glycol Feeder System; G

Water Treatment System; G, AE

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

1.4 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 12 00 STRUCTURAL STEEL.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.6 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.

Submit schematic control diagram showing equipment configuration, sequence

of operation, control and field devices, power connection and control wiring.

1.7 WARRANTY

Provide equipment with manufacturer's standard 2 year parts and labor warranty.

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) Fuel Burning Equipment
- (4) Combustion Control Equipment
- (5) Pumps
- (6) Fittings and Accessories
- (7) Packaged Glycol Feeder System
- (8) Water Treatment System

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. Catwalks, operating platforms, ladders, and guardrails shall be provided where shown and shall be constructed in accordance with Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

2.2 CONDENSING 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, natural draft/atmospheric burner, 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 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 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.

2.2.2 Packaged Factory Controls

Provide boiler with microprocessor controls to provide all control functions. Provide integral microprocessor based controller with built in source code sequence and controls, including necessary interlocks, safeties and alarms capable of complete standalone sequencing, monitoring and alarming.

Provide controller with single power point connection. Controller must be mounted integral to the equipment with operator interface and display, fully wired and configured at the factory.

The controller must be capable of BACnet communication protocol system interface as required in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.

Controller must communicate inputs/outputs to a heating hot water plant DDC system control panel. DDC control panel(s) must be provided with complete source code programming, and graphics for full integration of the heating hot water plant equipment. 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. Refer to control drawings for details.

2.2.3 Modular Configuration

Modular boilers shall be of the 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

Boiler shall be designed to burn natural gas. Each boiler shall comply with Federal, state, and local emission regulations.

2.3.1 Burners

2.3.1.1 Gas Fired Burners and Controls

Burners shall be UL approved mechanical draft burners with all air necessary for combustion supplied by a blower where the operation is coordinated with the burner. Burner shall be provided complete with fuel supply system in conformance with the following safety codes or standards:

- a. Gas-fired units with inputs greater than 400,000 Btuh per combustion chamber shall conform to UL 795. Single and multiple burner gas-fired units greater than or equal to 12,500,000 Btuh input shall conform to NFPA 85.

2.3.2 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 or axial flow type. 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.

2.3.2.1 Draft Fan Control

Forced-draft centrifugal fans shall have inlet vane controls or shall have variable speed control where indicated. Inlet vanes shall be suitable for use with combustion control equipment. Axial propeller fans shall have variable propeller pitch control.

2.3.2.2 Draft Fan Drives

Fans shall be driven by electric motors. Electric motor shall be totally enclosed fan cooled. Motor starter shall be magnetic across-the-line type with watertight, and dust-tight enclosure and shall be furnished with four auxiliary interlock contacts.

2.3.3 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 or damper motor.

2.3.4 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 Plant Master Controller

A boiler plant master controller, sensitive to a temperature transmitter in the return water header for the boiler shall be furnished to provide anticipatory signals to all boiler controllers. Boiler controllers shall react to anticipatory signals from the plant master controller as necessary in response to the boiler temperature indication to maintain the preset temperature. An automatic-manual switch shall be provided to allow the sequence of boiler loading to be varied to distribute equal firing time on all boilers in the plant. The plant master controller shall load the boilers one at a time as the plant load increases.

2.4.4 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.
- c. 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.
- d. High-low-off controls for boilers with capacities up to 2,000,000 Btuh shall use a water temperature controller in a temperature well in direct contact with the water.

2.4.5 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 .

2.4.5.1 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.

2.4.5.1.1 Pump Controller with Low-Water Cutoff

Controller shall be a design approved by the boiler manufacturer. A pump controller shall be provided for each boiler which is used for space heating and process steam loads or long distribution lines. Pump controller shall control the operation of the burner, forced-draft fan, and pump. Pump controller and low-water cutoff shall have a float-operated mercury switch arranged to start and stop the pump at preset boiler water levels. If the water level in the boiler reaches the low danger point, a second mercury switch shall shut down the burner and actuate the alarm bell.

2.4.5.1.2 Supplementary Low-Water Cutoff

Supplementary low-water cutoff of the electrically operated probe type shall be provided in addition to the low-water cutoff required above on each boiler. Supplementary low-water cutoff shall be mounted directly in the boiler shell and shall be set below the low-water cutoff required above.

2.4.5.2 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 PUMPS

2.5.1 Hot Water Circulating Pumps

Circulating pumps for hot water shall be electrically driven single-stage centrifugal type and have a capacity not less than indicated. Boiler circulating pumps shall be supported on a concrete foundation with a cast iron or structural steel base and shall be closed-coupled shaft or flexible-coupled shaft. The boiler circulating pumps shall be in

accordance with Section 23 21 23 HYDRONIC PUMPS inline type. Hot water circulating pumps shall be supported from the building structure with flex connections to the piping in which it is installed. The hot water circulating pumps shall be in accordance with Section 23 21 23 HYDRONIC PUMPS . The pump shaft shall be constructed of corrosion-resistant alloy steel, sleeve bearings and glands of bronze designed to accommodate a mechanical seal, and the housing of close-grained cast iron. Pump seals shall be capable of withstanding 240 degrees F temperature without external cooling. The motor shall have sufficient power for the service required, shall be of a type approved by the manufacturer of the pump, shall be suitable for the available electric service, and shall conform to the requirements of paragraph ELECTRICAL EQUIPMENT. Each pump suction and discharge connection shall be provided with a pressure gauge as specified. The hot water circulating pump discharge header shall be provided with a flow switch . Flow switch unit shall be a self-contained swinging vane type to indicate fluid flow. Switch shall be a SPDT with 120-volt, 15-ampere rating.

2.6 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.

2.7 UNIT HEATERS

Heaters shall be as specified below, and shall have a heating capacity not in excess of 125 percent of the capacity indicated. Noise level of each unit heater for areas noted shall not exceed the criteria indicated.

2.7.1 Propeller Fan Unit 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

Unit Capacity, cfm	Face Velocity, fpm
1,001 to 3,000	900
3001 and over	1,000

2.7.2 Centrifugal Fan Cabinet Unit Heaters

Heaters shall be arranged for floor or ceiling mounting as indicated. Heating elements and fans shall be housed in steel cabinets of sectionalized steel plates or reinforced with angle-iron frames. Cabinets shall be constructed of not lighter than 18 gauge black steel. Each unit heater shall be provided with a means of diffusing and distributing the air. Fans shall be mounted on a common shaft, with one fan to each air outlet. Fan shaft shall be equipped with self-aligning ball, roller, or sleeve bearings and accessible means of lubrication. Fan shaft may be either directly connected to the driving motor or indirectly connected by adjustable V-belt drive rated at 150 percent of motor capacity. All fans in any one unit heater shall be the same size.

2.7.3 Heating Elements

Heating coils shall be as specified in Section 23 30 00 HVAC AIR DISTRIBUTION for types indicated. Coils shall be suitable for use with water up to 250 degrees F.

2.7.4 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.

2.7.5 Motor Switches

Motors shall be provided with manual selection switches with "Off," and "Automatic" positions and shall be equipped with thermal overload protection.

2.7.6 Controls

Controls shall be provided as specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

2.8 OUTDOOR AIR HANDLING UNITS

Air handling units and associated equipment shall be in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION and Section 23 81 00 DECENTRALIZED UNITARY HVAC EQUIPMENT.

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 Schedule 40 CPVC or 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 scheduled. 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.

Hot water expansion tank shall also be in accordance with piping specialties in Section 23 05 15 COMMON PIPING FOR HVAC.

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.

Air separators shall also be in accordance with piping specialties in Section 23 05 15 COMMON PIPING FOR HVAC.

2.9.4 Filters

Filters shall conform to ASHRAE 52.2. Filters shall also be in accordance

with Section 23 30 00 HVAC AIR DISTRIBUTION.

2.9.5 Steel Sheets

2.9.5.1 Galvanized Steel

Galvanized steel shall be ASTM A653/A653M.

2.9.6 Gaskets

Gaskets shall be nonasbestos material in accordance with ASME B16.20, full face or self-centering type. The gaskets shall be of the spiral wound type with graphite filler material.

2.9.7 Steel Pipe and Fittings

Steel pipe and fittings shall be in accordance with Section 23 05 15 COMMON PIPING FOR HVAC.

2.9.8 Copper Tubing and Fittings

Copper tubing and fittings shall be in accordance with Section 23 05 15 COMMON PIPING FOR HVAC.

2.9.9 Dielectric Flanges

Dielectric flanges shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Flanges shall have metal connections on both ends suited to match connecting piping. Dielectric flanges shall include dielectric unions to prevent current flow between dissimilar metals.

2.9.10 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.

2.9.11 Pipe Supports

Pipe supports shall conform to MSS SP-58.

2.9.12 Pipe Expansion

2.9.12.1 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.

2.9.12.2 Expansion Joints

Pipe expansion joints shall be in accordance with piping specialties in Section 23 05 15 COMMON PIPING FOR HVAC.

2.9.13 Valves

Valves shall be in accordance with Section 23 05 15 COMMON PIPING FOR HVAC.

2.9.14 Strainers

Strainers shall be in accordance with piping specialties in Section 23 05 15 COMMON PIPING FOR HVAC.

2.9.15 Pressure Gauges

Pressure gauges shall be in accordance with piping specialties in Section 23 05 15 COMMON PIPING FOR HVAC.

2.9.16 Thermometers

Thermometers shall be in accordance with piping specialties in Section 23 05 15 COMMON PIPING FOR HVAC.

2.9.17 Air Vents

2.9.17.1 Manual Air Vents

Manual air vents shall be in accordance with piping specialties in Section 23 05 15 COMMON PIPING FOR HVAC.

2.9.17.2 Automatic Air Vents

Automatic air vents shall be in accordance with piping specialties in Section 23 05 15 COMMON PIPING FOR HVAC.

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 watertight 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 Breeching Cleaner

A cleaner shall be provided to clean the breeching. The cleaner shall have a jointed handle of sufficient length to clean the breeching without dismantling.

2.12.2 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

Boiler water treatment shall also be in accordance with Section 23 25 00 CHEMICAL TREATMENT OF WATER FOR MECHANICAL SYSTEMS.

Provide boiler manufacturer's condensate drain neutralizer kit; each boiler must have a dedicated condensate neutralizer kit.

2.13.1 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:

2.13.1.1 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.

2.13.1.2 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.

2.13.1.3 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.

2.13.1.4 Level Switch

Equipped with N/O and N/C contacts to activate upon sensing a low level condition.

2.13.1.5 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 inches or 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 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.

3.3.5 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 Brazed, 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 Supports

Supports shall also be in accordance with Section 23 05 48.19 BRACING FOR HVAC.

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.

3.3.8.1 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58, except as modified herein.

3.3.8.1.1 Types 5, 12, and 26

Use of Types 5, 12, and 26 is prohibited.

3.3.8.1.2 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.

3.3.8.1.3 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.

3.3.8.1.4 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.

3.3.8.1.5 Type 20 Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.3.8.1.6 Type 24

Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.3.8.1.7 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.

3.3.8.1.8 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.

3.3.8.1.9 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.

3.3.8.1.10 Horizontal Insulated Pipe

Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

3.3.8.1.11 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.

3.3.8.2 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.

3.3.9 Anchors

Anchors shall also be in accordance with Section 23 05 48.19 BRACING FOR HVAC.

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.

3.3.10 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.

3.3.11 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.

3.3.11.1 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.

3.3.11.2 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.

3.3.11.3 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, copper 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.

3.3.11.4 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.

3.3.12 Balancing Valves

Balancing valves shall be installed as indicated.

3.3.13 Thermometer Wells

Provide a thermometer well in each return line for each circuit in multicircuit systems.

3.3.14 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.

3.3.15 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.

3.3.16 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.

3.3.17 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.

3.3.18 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 NATURAL GAS FUEL SYSTEM

Natural 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. Circulating pump make, model, and rated capacity, and ammeter and voltmeter readings for pump motor during operation.
- j. Flue-gas temperature at boiler outlet.
- k. Percent carbon dioxide in flue-gas.
- l. Grade or type and calorific value of fuel.
- m. Draft at boiler flue-gas exit.
- n. Draft or pressure in furnace.
- o. Quantity of water circulated.
- p. Quantity of fuel consumed.
- q. 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 PECIAL CONTRACT REQUIREMENTS Provide necessary quantities of propane gas when propane gas is require for testing. Operating tests shall demonstrate that fuel burners and combustion and safety controls meet the requirements of ASME CSD-1 and NFPA 85

3.8.1 Water Treatment Testing

The boiler water shall be analyzed prior to the acceptance of the facility a minimum of once a month for a period of 1 year 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 (SiO ₂)	ppm (mg/l)
Insoluble	ppm (mg/l)
Iron and Aluminum Oxides	ppm (mg/l)
Calcium (Ca)	ppm (mg/l)
Magnesium (Mg)	ppm (mg/l)
Sodium and Potassium (Na and K)	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	epm (meq/l)
Noncarbonate Hardness	epm (meq/l)
Total Hardness	epm (meq/l)
Dissolved Solids	ppm (mg/l)
Fluorine	ppm (mg/l)
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 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. If corrosion is found within the boiler, proper repairs or replacement shall be made by the water treatment company.

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 12 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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 81 00

DECENTRALIZED UNITARY HVAC EQUIPMENT

05/18, CHG 1: 02/21

PART 1 GENERAL

- 1.1 RELATED REQUIREMENTS
- 1.2 REFERENCES
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
- 1.5 DELIVERY, STORAGE, AND HANDLING
- 1.6 ENVIRONMENTAL REQUIREMENTS
- 1.7 ACCESSIBILITY OF EQUIPMENT
- 1.8 WARRANTY

PART 2 PRODUCTS

- 2.1 ENERGY EFFICIENCY REQUIREMENTS
- 2.2 MATERIALS
 - 2.2.1 Standard Products
 - 2.2.2 Product Sustainability Criteria
 - 2.2.2.1 Energy Efficient Equipment
 - 2.2.2.2 Electrical Equipment / Motors
 - 2.2.2.3 Ozone Depleting Substances
 - 2.2.2.4 Local/Regional Materials
 - 2.2.2.5 Environmental Data
 - 2.2.3 Nameplates
 - 2.2.4 Safety Devices
- 2.3 EQUIPMENT
 - 2.3.1 Self-Contained Outdoor Air Handling Unit
 - 2.3.1.1 Large-Capacity Self-Contained Air Handling Unit DX Cooling, Hot Water Heating (Greater than 65,000 Btu/h)
 - 2.3.1.1.1 General
 - 2.3.1.1.2 Casing
 - 2.3.1.1.3 Air-to-Refrigerant Coils
 - 2.3.1.1.4 Compressor
 - 2.3.1.1.5 Refrigeration Circuit
 - 2.3.1.1.6 Unit Controls
 - 2.3.1.1.7 Supply and Return/Exhaust Air Fans
 - 2.3.1.1.8 Primary/Supplemental Heat
 - 2.3.1.1.8.1 Hot Water Coils
 - 2.3.1.1.9 Single Source Power Entry
 - 2.3.1.1.10 Fully Modulating Economizer
 - 2.3.1.1.11 Low Ambient Control
 - 2.3.1.1.12 Filters
 - 2.3.1.2 Mini-Split-System Air Conditioners
 - 2.3.2.1 Small-Capacity Split-System Air-Conditioners (Not Exceeding 65,000 Btu/hr)
 - 2.3.2.1.1 Energy Efficiency
 - 2.3.2.1.2 Air-to-Refrigerant Coil

- 2.3.2.1.3 Compressor
- 2.3.2.1.4 Refrigeration Circuit
- 2.3.2.1.5 Unit Controls
- 2.3.2.1.6 Condensing Coil
- 2.3.2.1.7 Remote Condenser or Condensing Unit
 - 2.3.2.1.7.1 Sound Rating
 - 2.3.2.1.7.2 Air-Cooled Condenser
- 2.3.2.1.8 Air Filters
- 2.3.2.1.9 Fans
- 2.4 COMPONENTS
 - 2.4.1 Refrigerant and Oil
 - 2.4.2 Fans
 - 2.4.3 Primary/Supplemental Heating
 - 2.4.3.1 Water Coil
 - 2.4.4 Air Filters
 - 2.4.4.1 Extended Surface Pleated Panel Filters
 - 2.4.4.2 Manometers
 - 2.4.5 Coil Frost Protection
 - 2.4.6 Pressure Vessels
 - 2.4.6.1 Liquid Receiver
 - 2.4.6.2 Oil Separator
 - 2.4.6.3 Oil Reservoir
 - 2.4.7 Internal Dampers
 - 2.4.8 Mixing Boxes
 - 2.4.9 Cabinet Construction
 - 2.4.9.1 Indoor Cabinet
 - 2.4.9.2 Outdoor Cabinet
 - 2.4.10 Refrigerant Piping
 - 2.4.11 Condensate Drain Piping
 - 2.4.12 Ductwork
 - 2.4.13 Temperature Controls
- 2.5 UNITARY EQUIPMENT ACCESSORIES AND MISCELLANEOUS EQUIPMENT
 - 2.5.1 Air Economizer
 - 2.5.2 Humidifier
 - 2.5.2.1 Steam Spray Type Humidifier
 - 2.5.2.2 Gaskets
 - 2.5.2.3 Bolts and Nuts
 - 2.5.2.4 Bird Screen
- 2.6 FINISHES
 - 2.6.1 Coil Corrosion Protection
 - 2.6.2 Equipment and Components Factory Coating
 - 2.6.2.1 Phenolic Coating
 - 2.6.3 Factory Applied Insulation
- 2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 INSTALLATION
 - 3.2.1 Equipment
 - 3.2.2 Mechanical Room Ventilation
 - 3.2.3 Field Applied Insulation
 - 3.2.4 Field Painting
- 3.3 CLEANING AND ADJUSTING
- 3.4 TRAINING
- 3.5 REFRIGERANT TESTS, CHARGING, AND START-UP
 - 3.5.1 Refrigerant Leakage
 - 3.5.2 Contractor's Responsibility
- 3.6 SYSTEM PERFORMANCE TESTS

Joint Cryptologic Center Building - Buckley SFB, CO

BU81

3.7 MAINTENANCE

3.7.1 EXTRA MATERIALS

3.7.2 Maintenance Service

-- End of Section Table of Contents --

SECTION 23 81 00

DECENTRALIZED UNITARY HVAC EQUIPMENT
05/18, CHG 1: 02/21

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

Equipment or systems specified in this section are part of the commissioning process. Refer to Section 01 91 00.15 10, TOTAL BUILDING COMMISSIONING for additional requirements.

1.2 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 500-D	(2018) Laboratory Methods of Testing Dampers for Rating
------------	--

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 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 270	(2008) Sound Rating of Outdoor Unitary 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
---------------	--

ANSI/AHRI 640	(2005) Performance Rating of Commercial and Industrial Humidifiers
---------------	---

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	(2017) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62.1	(2010) Ventilation for Acceptable Indoor Air Quality
ASHRAE 90.1 - IP	(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 1-4 2020; Interpretation 5-8 2021; Addenda AS-CB 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	(2012) Safety in Welding and Cutting and Allied Processes
-----------	---

ASTM INTERNATIONAL (ASTM)

ASTM A307	(2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C1071	(2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM E84	(2020) Standard Test Method for Surface

Burning Characteristics of Building Materials

ASTM E2129 (2018) Standard Practice for Data Collection for Sustainability Assessment of Building Products

ASTM F104 (2011; R 2020) Standard Classification System for Nonmetallic Gasket Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

NEMA MG 2 (2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82 Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 207 (2009; Reprint Jan 2020) Refrigerant-Containing Components and Accessories, Nonelectrical

UL 586 (2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units

UL 900 (2015) Standard for Air Filter Units

UL 1995 (2015) UL Standard for Safety Heating and Cooling Equipment

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval 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

Spare Parts; G

Posted Instructions; G

Coil Corrosion Protection; G

System Performance Tests; G

Training; G

Inventory; G

Environmental Data; G

Supplied Products; G

Manufacturer's Standard Catalog Data; G

Humidifier; G

Outdoor Air Handling Unit; G

Mini Split System Air Conditioners; G

Refrigerants; G

Ozone Depleting Substances; G

SD-06 Test Reports

Refrigerant Tests, Charging, and Start-Up; G, AE

System Performance Tests; G, AE

SD-07 Certificates

Service Organizations; G

Ozone Depleting Substances Technician Certification; G

SD-10 Operation and Maintenance Data

Installation Manual for Each Type of Equipment; G

Operation and Maintenance Manuals; G

SD-11 Closeout Submittals

Ozone Depleting Substances; S

1.4 QUALITY ASSURANCE

Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. Submit drawings consisting of:

- a. Equipment layouts which identify assembly and installation details.
- b. Plans and elevations which identify clearances required for maintenance and operation.
- c. Wiring diagrams which identify each component individually and interconnected or interlocked relationships between components.
- d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for equipment indicated or required to have concrete foundations.

- e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.
- f. Automatic temperature control diagrams and control sequences.
- g. Installation details which includes the amount of factory set superheat and corresponding refrigerant pressure/temperature.
- h. Equipment schedules
- i. 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.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored items from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Properly protect and care for all material both before and during installation. 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.

1.6 ENVIRONMENTAL REQUIREMENTS

For proper Indoor Environmental Quality, maintain pressure within the building as indicated. Ventilation must meet or exceed ASHRAE 62.1 and all published addenda. Meet or exceed filter media efficiency as tested in accordance with ASHRAE 52.2.

1.7 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.

1.8 WARRANTY

Provide equipment with manufacturer's standard 2 year parts and labor warranty. Provide equipment compressors with 5 year parts and labor warranty, and an additional 5 years parts only (10 years total time period) warranty.

PART 2 PRODUCTS

2.1 ENERGY EFFICIENCY REQUIREMENTS

42 USC 8259b requires the procurement of energy efficient products in product categories covered by the Energy Star program or the Federal Energy Management Program for designated products. A list of covered product categories is available from the Federal Energy Management Web site at <http://energy.gov/eere/femp/covered-product-categories>.

Submit Material, Equipment, and Fixtures List of all supplied products within a covered product category, including manufacturer's catalog numbers, specification and drawing reference number, warranty information, fabrication site, and energy performance data. For product categories covered by the Federal Energy Management Program, submit documentation that the product meets or exceeds FEMP-designated efficiency requirements.

2.2 MATERIALS

Provide Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data includes manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit data for each specified component. Minimum efficiency requirements must be in accordance with ASHRAE 90.1 - IP.

2.2.1 Standard Products

Provide materials and equipment that are standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2 year use includes applications of equipment and materials under similar circumstances and of similar size. The 2 years' experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a 2 year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Products must be supported by a service organization. Ensure system components are environmentally suitable for the indicated geographic locations.

2.2.2 Product Sustainability Criteria

2.2.2.1 Energy Efficient Equipment

Provide equipment meeting the efficiency requirements as stated within this section and provide documentation in conformance with Section 01 33 29 SUSTAINABILITY REQUIREMENTS AND REPORTING paragraph ENERGY EFFICIENT EQUIPMENT.

2.2.2.2 Electrical Equipment / Motors

Provide electrical equipment, motors, motor efficiencies, and wiring which are in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical motor driven equipment specified must be provided complete with motors, motor starters, and controls. Electrical characteristics must be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, totally enclosed, or explosion proof fan cooled enclosures, must be the premium efficiency type in accordance with NEMA MG 1. Field wiring must be in accordance with manufacturer's instructions. Each motor must conform to NEMA MG 1 and NEMA MG 2 and be

of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Motors must be continuous duty with the enclosure specified. Motor starters must be provided complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Motors must be furnished with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motors must be sized for the applicable loads. Motor torque must be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings must be fitted with grease supply fittings and grease relief to outside of enclosure. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, must be provided.

Unless otherwise indicated and scheduled on drawings, provide equipment motor selections that do not exceed 1,800 rpm

2.2.2.3 Ozone Depleting Substances

Unitary air conditioning equipment must not use CFC-based refrigerants. Refrigerant shall 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.

HVAC systems must follow the regulations of Colorado Regulation 22: Manufacturers/sellers in the State of Colorado of air-conditioning, refrigeration, foam, or aerosol propellant products, must provide a written disclosure to the buyer as part of the sales transaction and invoice or a label on the product or equipment. Refer to <https://www.epa.gov/snap/substitutes-refrigeration-and-air-conditioning> for all prohibited refrigerants and substitutions.

2.2.2.4 Local/Regional Materials

Use 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.

2.2.2.5 Environmental Data

Submit Table 1 of ASTM E2129 for all following products..

2.2.3 Nameplates

Major equipment including compressors, condensers, receivers, heat exchanges, fans, and motors must have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment. Plates must be durable and legible throughout equipment life and made of stainless steel. Fix plates in prominent locations with nonferrous screws or bolts.

2.2.4 Safety Devices

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to

operating personnel must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

2.3 EQUIPMENT

Provide installation manual for each type of equipment.

2.3.1 Self-Contained Outdoor Air Handling Unit

2.3.1.1 Large-Capacity Self-Contained Air Handling Unit DX Cooling, Hot Water Heating (Greater than 65,000 Btu/h)

2.3.1.1.1 General

Provide an air-cooled, factory assembled, weatherproof packaged unit for horizontal airflow suitable for outdoor installation. Exterior panels must be zinc coated galvanized steel phosphatized and painted. All access doors and panels must be hinged with neoprene gaskets. Unit must be listed, labeled, and classified in accordance with UL 1995. Unit must be rated in accordance with ANSI/AHRI 210/240. Provide unit with equipment as specified in paragraph UNITARY EQUIPMENT COMPONENTS. Evaporator or supply fans must be direct drive forward curved centrifugal scroll type. Condenser fans must be manufacturer's standard for the unit specified and may be propeller type. Provide unit with a full factory operating charge of refrigerant. Unit must be 100 percent run tested at the factory. No penetrations are allowed within the perimeter of the curb in the down flow unit's base pan other than the raised 1-1/8 inch high supply/return openings to provide added water integrity precaution from condensate drain back up.

Provide a belt driven, forward curved centrifugal indoor fan with adjustable motor sheaves. Thermally protect all motors. Provide unit with a removable, reversible, double-sloped condensate drain pan. Provide unit with hot gas reheat.

2.3.1.1.2 Casing

Construct exterior casings for the specified unitary equipment of factory phosphatized and painted galvanized steel or aluminum sheet metal and galvanized or aluminum structural members. Fit casing with lifting provisions, access panels or doors, fan vibration isolators, electrical control panel, corrosion-resistant components, structural support members, insulated condensate drip pan and drain, and internal insulation in the cold section of the casing. All access doors and panels must have neoprene gaskets. Casing must have double-wall, hinged access doors for filters, heating, return/exhaust air, and supply fan section. Incorporate provisions to permit replacement of major unit components. Seal penetrations of cabinet surfaces, including the floor. Unit base must be watertight. Fit unit with a drain pan which extends under all areas where water may accumulate. Fabricate drain pan from Type 30X stainless steel, galvanized steel with protective coating, 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.

2.3.1.1.3 Air-to-Refrigerant Coils

Provide air-to-refrigerant coils and hot gas reheat coils with seamless copper or aluminum tubes of 5/16 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 ANSI/ASHRAE 15 & 34 at the factory and must be suitable for the working pressure of the installed system. Factory pressure and leak test each coil.

- a. Provide separate expansion devices for each compressor circuit. Condensate drain pans must be removable and double-sloped.
- b. Dual compressor units must have intermingled evaporator coils.
- c. Condensate drain pans must be removable and double-sloped.
- d. Provide condenser coils with hail protection guards.
- e. Coat condenser and evaporator coil with a uniformly applied epoxy electrodeposition, phenolic, or vinyl type coating to all coil surface areas without material bridging between fins. Apply coating at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation. Coating must be capable of withstanding a minimum 1000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.3.1.1.4 Compressor

Provide direct drive, scroll type variable capacity compressor. Compressor must have internal over current and over temperature protection, internal pressure relief, high pressure cutout, rotor lock suction and discharge refrigerant connections, centrifugal oil pump, vibration isolation, and discharge refrigerant connections. Compressors must have crankcase heaters. Motor must be suction gas-cooled. Cooling partial load capacity must be provided by a variable speed compressor.

2.3.1.1.5 Refrigeration Circuit

Refrigerant containing components must comply with ANSI/ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Provide refrigerant lines with service pressure tap ports and refrigerant line filter.

2.3.1.1.6 Unit Controls

Provide units internally prewired by manufacturer with a 24 volt electromechanical control circuit powered by an internal transformer. Provide terminal blocks for power wiring and external control wiring. Internally protect unit by fuses or a circuit breaker in accordance with UL 1995. Units with three-phase power must be equipped with phase monitoring protection to protect against problems caused by phase loss, phase imbalance and phase reversal.

- a. Provide unit with microprocessor controller to provide all control functions with built in source code sequence and controls, including necessary interlocks, safeties and alarms capable of complete standalone sequencing, monitoring and alarming.

- b. Provide controller with single power point connection. Controller must be mounted integral to the equipment with operator interface and display, fully wired and configured at the factory.
- c. The controller must be capable of BACnet communication protocol system interface as required in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.
- d. Controller must communicate inputs/outputs to the DDC system control panel. DDC control panel(s) must be provided with complete source code programming, and graphics for integration of air handling system equipment. 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. Refer to control drawings for details.

2.3.1.1.7 Supply and Return/Exhaust Air Fans

Units must have supply fans and return/exhaust air fans controlled by factory provided variable speed motors, each with a dedicated factory provided variable frequency drive.

Provide direct drive, forward curved, centrifugal scroll type supply air fan or provide supply air plenum fan with backward-curved fan wheel.

Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS.

2.3.1.1.8 Primary/Supplemental Heat

Provide heating unit with internal thermal insulation having a fire hazard rating not to exceed 25 for flame spread and 50 for smoke developed as determined by ASTM E84.

2.3.1.1.8.1 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.

Hot water coils shall also be in accordance with coils in 23 30 00 HVAC AIR DISTRIBUTION.

2.3.1.1.9 Single Source Power Entry

Provide single source power entry to allow single source power connection to unit and heater combination. Single source power entry kit includes specific matching heater(s), high voltage terminal blocks, fuse blocks and fuses, cut-to-length interconnecting wiring, and junction box (if required) to provide power sources with fuse protection as required for both the unit and accessory heater.

2.3.1.1.10 Fully Modulating Economizer

Provide fully modulating economizer to include 0-100 percent fresh air damper, damper drive motor, and fixed dry bulb enthalpy control. Control economizer operations by the pre-set position of the enthalpy control.

Include a barometric relief damper with the down flow economizer to provide a pressure operated damper that is gravity closing and prohibits entrance of outside air on equipment "off" cycle. Economizer dampers must be ultra low-leak type with leakage rate of one percent based on testing data completed in accordance with AMCA 500-D.

Provide outside air damper, relief air damper and return air damper each with an independent motorized electric actuator.

2.3.1.1.11 Low Ambient Control

Provide low ambient control to allow cycling of compressor for cooling operation at low ambient temperatures down to 0 degrees F.

2.3.1.1.12 Filters

Provide 2 inch thick throwaway type pre-filters that are MERV 8. Provide 2 inch thick high efficiency throwaway type filters that are MERV 13.

2.3.2 Mini-Split-System Air Conditioners

2.3.2.1 Small-Capacity Split-System Air-Conditioners (Not Exceeding 65,000 Btu/hr)

Provide an air-cooled, split system which employs a remote condensing unit, a separate wall mounted highwall type or ceiling mounted cassette type indoor unit, and interconnecting refrigerant piping. Provide the air conditioning only as scheduled type unit conforming to applicable Underwriters Laboratories (UL) standards including UL 1995. Unit must be rated in accordance with 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. Fan and condenser motors must have totally enclosed enclosures. Design unit to operate at outdoor ambient temperatures up to 115 degrees F.

2.3.2.1.1 Energy Efficiency

Provide unit with an Energy Star label. Air Conditioners must have a minimum seasonal energy efficiency ratio (SEER) of 11.0, and a minimum COP of 3.2.

2.3.2.1.2 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.

Coat condenser and evaporator coil with a uniformly applied epoxy electrodeposition or phenolic type coating to all coil surface areas without material bridging between fins. Apply coating at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation and be capable of withstanding a minimum 3,000 hours

exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.3.2.1.3 Compressor

Provide direct drive variable speed digital 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.

2.3.2.1.4 Refrigeration Circuit

Refrigerant-containing components must comply with ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged, and sealed. Provide each unit with a factory operating charge of refrigerant and oil or a holding charge. Field charge unit shipped with a holding charge. Provide refrigerant charging valves. Provide filter-drier in liquid line to prevent freeze-up in event of loss of water flow during heating cycle.

2.3.2.1.5 Unit Controls

Provide unit internally prewired with a 24 volt control circuit powered by an internal transformer. Provide terminal blocks for power wiring and external control wiring. Internally protect unit by fuses or a circuit breaker in accordance with UL 1995. Equip units with three-phase power with phase monitoring protection to protect against problems caused by phase loss, phase imbalance and phase reversal.

- a. Provide unit with microprocessor controls to provide all 24V control functions. Provide integral microprocessor based controller with built in source code sequence and controls, including necessary interlocks, safeties and alarms capable of complete standalone sequencing, monitoring and alarming.
- b. Provide controller with single power point connection. Controller must be mounted integral to the equipment with operator interface and display, fully wired and configured at the factory.
- c. The controller must be capable of BACnet communication protocol system interface as required in Section 23 09 23.02 BACNET DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS.
- d. Controller must communicate inputs/outputs to a dedicated air handling unit DDC system control panel. Dedicated DDC control panel(s) must be provided with complete source code programming, and graphics for full integration of air handling system equipment. 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. Refer to control drawings for details.

2.3.2.1.6 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. Protect coil in accordance with paragraph CORROSION PROTECTION. 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 each coil after testing and prior to evaluation and charging. Provide separate expansion devices for each compressor circuit.

2.3.2.1.7 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 0 degrees F. Provide fan and cabinet construction as specified in paragraph UNITARY EQUIPMENT ACCESSORIES. Fan and condenser motors must have drip proof enclosures. Condensing unit must have controls to initiate a refrigerant pump down cycle at system shut down on each refrigerant circuit.

2.3.2.1.7.1 Sound Rating

Provide units of capacities less than 135,000 Btu/h with a maximum AHRI sound rating of 65 dB when rated in accordance with ANSI/AHRI 270.

2.3.2.1.7.2 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.

2.3.2.1.8 Air Filters

Provide filters of the disposable panel or cleanable 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). 2 inch MERV 8, provide throwaway filter on all units below 6 Tons.

Provide filter rack that can be converted to 2.0 inch capability. Filters must have an average dust spot efficiency of 25-35 percent and an average arrestance of 90 percent when tested in accordance with ASHRAE 52.2. Provide UL Class 1 filters.

2.3.2.1.9 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.

2.4 COMPONENTS

2.4.1 Refrigerant and Oil

Refrigerant must be one of the fluorocarbon gases. Refrigerants must have an Ozone Depletion Potential (ODP) no greater than 0.0, with the exception of R-123. CFC-based refrigerants are prohibited. HCFCs and Halons are not permitted. Refrigerants must have number designations and safety classifications in accordance with ASHRAE 15 & 34. Refrigerants must meet the requirements of AHRI 700 as a minimum. Provide a complete charge of refrigerant for the installed system as recommended by the manufacturer.

Lubricating oil must be of a type and grade recommended by the manufacturer for each compressor. Where color leak indicator dye is incorporated, charge must be in accordance with manufacturer's recommendation.

2.4.2 Fans

Fan wheel shafts must be supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Unit fans must be selected to produce the cfm required at the fan total pressure. Motor starters, if applicable, must be magnetic across-the-line type with a drip-proof enclosure. Thermal overload protection must be of the manual or automatic-reset type. Fan wheels or propellers must be constructed of aluminum or galvanized steel. Centrifugal fan wheel housings must be of galvanized steel, and both centrifugal and propeller fan casings must be constructed of aluminum or galvanized steel. Steel elements of fans, except fan shafts, must be hot-dipped galvanized after fabrication or fabricated of mill galvanized steel. Mill-galvanized steel surfaces and edges damaged or cut during fabrication by forming, punching, drilling, welding, or cutting must be recoated with an approved zinc-rich compound. Fan wheels or propellers must be statically and dynamically balanced. Forward curved fan wheels must be limited to 20 inches. Direct-drive fan motors must be of the multiple-speed variety. Belt-driven fans must have adjustable sheaves to provide not less than 30 percent fan-speed adjustment. The sheave size must be selected so that the fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. Centrifugal scroll-type fans must be provided with streamlined orifice inlet and V-belt drive. Each drive will be independent of any other drive. Propeller fans must be direct-drive type with fixed pitch blades. V-belt driven fans must be mounted on a corrosion protected drive shaft supported by either maintenance-accessible lubricated antifriction block-type bearings, or permanently lubricated ball bearings. Each drive will be independent of any other drive. Drive bearings must be protected with water slingers or shields. V-belt drives must be fitted with guards where exposed to contact by personnel and adjustable pitch sheaves.

2.4.3 Primary/Supplemental Heating

2.4.3.1 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.

2.4.4 Air Filters

Air filters shall be as specified in Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM for types indicated. Provide MERV 8 prefilter and MERV 13 final filter 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.

2.4.4.1 Extended Surface Pleated Panel Filters

MERV 8 prefilter and MERV 13 final filter 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.

2.4.4.2 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.

2.4.5 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.

2.4.6 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.

2.4.6.1 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.

2.4.6.2 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, and strainer.

2.4.6.3 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.

2.4.7 Internal Dampers

Dampers must be parallel blade type with renewable blade seals and be integral to the unitary unit. Damper provisions must be provided for each outside air intake, exhaust, economizer, and mixing boxes. Dampers must have minimum position stops and have automatic modulation and operate as specified.

2.4.8 Mixing Boxes

Mixing boxes must match the base unit in physical size and must include equally-sized flanged openings, each capable of full air flow. Arrangement must be as indicated.

2.4.9 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 316 stainless steel. Pan insulation must

be water impervious. Extent and effectiveness of the insulation of unit air containment surfaces must prevent, within limits of the specified insulation, heat transfer between the unit exterior and ambient air, heat transfer between the two conditioned air streams, and condensation on surfaces. Insulation must conform to ASTM C1071. Paint and finishes must comply with the requirements specified in paragraph FACTORY COATING.

2.4.9.1 Indoor Cabinet

Indoor cabinets must be suitable for the specified indoor service and enclose all unit components.

2.4.9.2 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.

2.4.10 Refrigerant Piping

Provide refrigerant piping in accordance with Section 23 23 00 REFRIGERANT PIPING.

2.4.11 Condensate Drain Piping

provide condensate drain piping in accordance with Section 23 05 15 COMMON PIPING FOR HVAC.

2.4.12 Ductwork

Provide ductwork in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

2.4.13 Temperature Controls

Temperature controls shall be in accordance with Section 23 09 23.02 BACnet DIRECT DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS fully coordinated with and integrated into the air-conditioning system.

2.5 UNITARY EQUIPMENT ACCESSORIES AND MISCELLANEOUS EQUIPMENT

2.5.1 Air Economizer

Provide horizontal flow factory installed economizer with fully modulating 0-100 percent motor and dampers, barometric relief, minimum position setting and fixed dry bulb. Factory installed dry bulb enthalpy control.

2.5.2 Humidifier

Provide humidifiers that meet the requirements of ANSI/AHRI 640

2.5.2.1 Steam Spray Type Humidifier

Provide steam spray humidifiers that inject steam directly into the air stream. Single grid humidifiers must consist of a single Type 316 stainless steel distribution grid with pipe connection on one end and cap on the other end.

Humidifier steam generator must be electric type capable of utilizing untreated potable makeup water supply. Provide dedicated separate power feed connection to electric steam generator.

Field install automatic steam control valves and condenser traps. Equip package type steam spray humidifiers to trap out and to evaporate condensate and to supply dry steam to a single distribution grid. Grid must be steam jacketed and condensate drained. Unit must trap excess condensate to return system.

Package type steam spray humidifiers must have modulating electric or electronic steam control valve. Steam spray humidifiers must be rated for humidifying capacity in pounds of steam per hour and at steam pressure as indicated.

2.5.2.2 Gaskets

Provide gaskets conforming to ASTM F104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.5.2.3 Bolts and Nuts

Bolts and nuts must be in accordance with ASTM A307. The bolt head must be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307.

2.5.2.4 Bird Screen

Screen must be 0.063 inch diameter aluminum wire or 0.031 inch diameter stainless steel wire.

2.6 FINISHES

2.6.1 Coil Corrosion Protection

Provide coil with a uniformly applied epoxy electrodeposition, phenolic, or vinyl type coating to all coil surface areas without material bridging between fins. Submit product data on the type coating selected, the coating thickness, the application process used, the estimated heat transfer loss of the coil, and verification of conformance with the salt spray test requirement. Coating must be applied at either the coil or coating manufacturer's factory. Coating process must ensure complete coil encapsulation. Coating must be capable of withstanding a minimum 1,000 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution.

2.6.2 Equipment and Components Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand 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.

Where stipulated in equipment specifications of this section, coat finned tube coils of the affected equipment as specified below. Apply coating at the premises of a company specializing in such work. Degrease and prepare for coating in accordance with the coating applicator's procedures for the type of metals involved. Completed coating must show no evidence of softening, blistering, cracking, crazing, flaking, loss of adhesion, or "bridging" between the fins.

2.6.2.1 Phenolic Coating

Provide a resin base thermosetting phenolic coating. Apply coating by immersion dipping of the entire coil. Provide a minimum of two coats. Bake or heat dry coils following immersions. After final immersion and prior to final baking, spray entire coil with particular emphasis given to building up coating on sheared edges. Total dry film thickness must be 2.5 to 3.0 mils.

2.6.3 Factory Applied Insulation

Refrigeration equipment must be provided with factory installed insulation on surfaces subject to sweating including the suction line piping. Where motors are the gas-cooled type, factory installed insulation must be provided on the cold-gas inlet connection to the motor in accordance with manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors must have a flame spread index no higher than 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.

2.7 TESTS, INSPECTIONS, AND VERIFICATIONS

All manufactured units must be inspected and tested, and documentation provided to demonstrate that each unit is in compliance with ANSI/AHRI and UL requirements and that the minimum efficiency requirements of ASHRAE 90.1 - IP have been met.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, perform Verification of Dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION

Perform work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements. Where equipment is

specified to conform to the requirements of ASME BPVC SEC VIII D and ASME BPVC SEC IX, the design, fabrication, and installation of the system must conform to ASME BPVC SEC VIII D1 and ASME BPVC SEC IX.

3.2.1 Equipment

Provide refrigeration equipment conforming to ASHRAE 15 & 34. Provide necessary supports for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, and similar items. Isolate compressors from the building structure. If mechanical vibration isolators are not provided, provide vibration absorbing foundations. Each foundation must include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment must be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps must have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block must be of mass not less than three times the combined pump, motor, and base weights. Isolators must be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators must limit vibration to 10-20 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 Mechanical Room Ventilation

Provide mechanical ventilation systems as indicated in design drawings and in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

3.2.3 Field Applied Insulation

Apply field applied insulation as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.2.4 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory are specified herein.

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 16 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, installation 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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 81 23

COMPUTER ROOM AIR CONDITIONING UNITS

11/20

PART 1 GENERAL

- 1.1 RELATED REQUIREMENTS
- 1.2 REFERENCES
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS
- 1.5 REFRIGERANTS
- 1.6 QUALIFICATIONS
 - 1.6.1 Ozone Depleting Substances Technician Certification
- 1.7 QUALIFICATIONS
 - 1.7.1 Material and Equipment Qualifications
 - 1.7.2 Alternative Equipment Qualifications
 - 1.7.3 Service Support
 - 1.7.4 Manufacturer's Nameplate
 - 1.7.5 Modification of References
 - 1.7.5.1 Definitions
 - 1.7.5.2 Administrative Interpretations
- 1.8 PROJECT REQUIREMENTS
 - 1.8.1 Verification of Dimensions
 - 1.8.2 Energy Efficiency
- 1.9 DELIVERY, STORAGE, AND HANDLING

PART 2 PRODUCTS

- 2.1 COMPUTER ROOM AIR CONDITIONER (CRAC)
 - 2.1.1 Unit Airflow Configuration
 - 2.1.1.1 In-row Units
 - 2.1.2 Cabinet and Frame
 - 2.1.2.1 Unit Frame
 - 2.1.2.2 Unit Cabinet
 - 2.1.3 Fan Section
 - 2.1.3.1 Fan Wheel
 - 2.1.3.2 Motor and Drive
 - 2.1.4 Cooling Coil and Integral Condensate Pump
 - 2.1.5 Filters
 - 2.1.6 Hot Gas Reheat Coil
 - 2.1.7 Humidifier
 - 2.1.8 Compressor
 - 2.1.8.1 Refrigeration Circuit
 - 2.1.9 Condenser
 - 2.1.9.1 Air-cooled Condenser
 - 2.1.9.1.1 Condenser Fans
 - 2.1.9.1.2 Condenser Coils
 - 2.1.9.1.3 Unit Casing
- 2.2 COLD AND HOT AISLE CONTAINMENT SYSTEMS
- 2.3 INSTRUMENTATION AND CONTROLS

- 2.3.1 Unit Level Controls
 - 2.3.1.1 Display Panel
 - 2.3.1.2 Alarms
 - 2.3.1.3 Leak Detection
 - 2.3.1.4 Factory Wired Components
- 2.3.2 Supervisory CRAC Controls
- 2.3.3 Integration to HVAC control system
- 2.4 CORROSION PROTECTION
 - 2.4.1 Phenolic Finish Coating System
 - 2.4.1.1 Heat Exchanger Coil (Including Evaporator Coil) Surfaces
 - 2.4.1.2 Uninsulated Interior Surfaces and Exterior Surfaces
 - 2.4.1.3 Insulated Interior Surfaces
- 2.5 FACTORY PAINTING SYSTEMS
- 2.6 ELECTRICAL
 - 2.6.1 Electrical Motors, Controllers, Contactors, and Disconnects
 - 2.6.2 Electrical Installations
 - 2.6.2.1 New Work
 - 2.6.2.2 Modifications to Existing Systems
 - 2.6.2.3 High Efficiency Motors
 - 2.6.2.3.1 High Efficiency Single-Phase Motors
 - 2.6.2.3.2 High Efficiency Polyphase Motors
 - 2.6.2.4 Three-Phase Motor Protection
 - 2.6.3 Electrical Control Wiring
- 2.7 FIRE PROTECTION DEVICES
- 2.8 SOURCE QUALITY CONTROL
 - 2.8.1 Manufacturer's Factory Test Plans
 - 2.8.1.1 Test Procedure
 - 2.8.1.2 Performance Variables
 - 2.8.1.3 Test Configuration
 - 2.8.1.4 Tested Variables
 - 2.8.1.5 Thermal Testing
 - 2.8.1.6 Specialized Components
 - 2.8.1.7 Factory Test For Sound Pressure Level
 - 2.8.1.8 Factory Tests Reporting Forms
 - 2.8.2 Factory Tests
 - 2.8.3 Deficiency Resolution
 - 2.8.4 Factory Test Reports
- 2.9 OZONE DEPLETING SUBSTANCES

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 CRAC System
 - 3.1.2 Installation Instructions
 - 3.1.3 Operation and Maintenance Data
 - 3.1.4 Connections to Existing Systems
- 3.2 FIELD QUALITY CONTROL
- 3.3 FIELD TESTING
 - 3.3.1 Manufacturer's Field Test Plans
 - 3.3.1.1 Coordinated Testing
 - 3.3.1.2 Prerequisite Testing
 - 3.3.1.3 Test Procedure
 - 3.3.1.4 Performance Variables
 - 3.3.1.5 Test Configuration
 - 3.3.1.6 Tested Variables
 - 3.3.1.7 Thermal Testing
 - 3.3.1.8 Specialized Components
 - 3.3.1.9 Field Test Reporting Forms
 - 3.3.2 Field Test Schedule

- 3.3.3 Manufacturer's Test Representative
- 3.3.4 Field Tests
- 3.3.5 Deficiency Resolution
- 3.3.6 Field Test Reports
- 3.4 INSTRUCTION TO GOVERNMENT PERSONNEL

-- End of Section Table of Contents --

SECTION 23 81 23

COMPUTER ROOM AIR CONDITIONING UNITS
11/20

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

Equipment or systems specified in this section are part of the commissioning process. Refer to Section 01 91 00.15 10, TOTAL BUILDING COMMISSIONING for additional requirements.

1.2 REFERENCES

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

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 410 (2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils

AHRI 1360 (2017) Performance Rating of Computer and Data Processing Room Air Conditioners

ANSI/AHRI 460 (2005) Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers

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 52.2 (2017) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

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 1-4 2020; Interpretation 5-8 2021; Addenda AS-CB 2022) Energy Standard for Buildings Except Low-Rise Residential Buildings

ASHRAE 127 (2020) Method of Testing for Rating Computer and Data Processing Room Unitary Air-Conditioners

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1 (2020) Power Piping

ASME B31.5 (2020) Refrigeration Piping and Heat Transfer Components

ASTM INTERNATIONAL (ASTM)

ASTM B117 (2019) Standard Practice for Operating Salt Spray (Fog) Apparatus

ASTM D5864 (2011) Standard Test Method for Determining Aerobic Aquatic Biodegradation of Lubricants or Their Components

ASTM D6081 (1998; R 2014) Aquatic Toxicity Testing of Lubricants: Sample Preparation and Results Interpretation

ASTM E84 (2020) Standard Test Method for Surface Burning Characteristics of Building Materials

ETL TESTING LABORATORIES (ETL)

ETL DLP (updated continuously) ETL Listed Mark Directory

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

NEMA MG 10 (2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors

NEMA MG 11 (1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 1110-2-1424 (2016) Engineering and Design -- Lubricants and Hydraulic Fluids

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201 Safety Standard for Architectural Glazing
Materials

40 CFR 82 Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 94 (2013; Reprint May 2021) 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 Elec Equip Dir (2011) Electrical Appliance and
Utilization Equipment Directory

1.3 DEFINITIONS

Computer Room Air Conditioner (CRAC): A single, self-contained unit or split-system unit designed and manufactured specifically for temperature and humidity control of data processing environments.

Cold Aisle: The aisle between or adjacent to rows of racks from which the computing equipment draws cool air.

Hot Aisle: The aisle between or adjacent to rows of racks to which the computing equipment ejects hot air.

Rack: Telecommunications support frame that can consist of post-and-frame or full cabinet construction. Racks are provided under Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

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 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

Computer Room Air Conditioner; G

Space Temperature Control System Drawings; G, AE

Filters

Refrigerants; S

Cold And Hot Aisle Containment Systems; G
Leak Detection; G

Ozone Depleting Substances; G, AE

SD-06 Test Reports

Manufacturer's Factory Test Plans; G, AE

Factory Test Reports; G, AE

Field Test Schedule; G, AE

Manufacturer's Field Test Plans; G, AE

Field Test Reports; G, AE

SD-07 Certificates

Certificate of Specification Compliance; G, AE

Credentials of the Manufacturer's Field Test Representative; G, AE

Ozone Depleting Substances Technician Certification

Certified List Of Qualified Permanent Service Organizations

SD-08 Manufacturer's Instructions

Installation Manual for Each Type of CRAC

Installation Manual for Each Type of Aisle Containment System

SD-10 Operation and Maintenance Data

Computer Room Air Conditioner Operation and Maintenance Data, Data Package 4; G, AE

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

1.5 REFRIGERANTS

Refrigerants must have an Ozone Depletion Potential (ODP) no greater than 0.0. CFC-based refrigerants are prohibited. HCFCs and Halons are not permitted. Provide SDS sheets for all refrigerants.

1.6 QUALIFICATIONS

1.6.1 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.

1.7 QUALIFICATIONS

1.7.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design, and workmanship. Standard products must have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year use must include applications of equipment and materials under similar circumstances and of similar size. The product must have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the two-year period.

1.7.2 Alternative Equipment 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.

1.7.3 Service Support

The equipment items must be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations must be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7.4 Manufacturer's Nameplate

For each item of equipment, provide a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.7.5 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.7.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions must be considered mandatory, the word "should" is interpreted as "must." Reference to the "code official" must be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" must be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" must be interpreted to mean the "lessor." References to the "permit holder" must be interpreted to mean the "Contractor."

1.7.5.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of

Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, must be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.8 PROJECT REQUIREMENTS

1.8.1 Verification of Dimensions

Become familiar with the details of the work, verify all dimensions in the field, and provide adequate clearance for all connections and service access. Notify the Contracting Officer of any discrepancy before performing any work.

1.8.2 Energy Efficiency

Provide equipment with minimum efficiencies as required by ASHRAE 90.1 - IP.

1.9 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.

PART 2 PRODUCTS

2.1 COMPUTER ROOM AIR CONDITIONER (CRAC)

Provide complete working CRACs, designed, and factory assembled, and factory tested with configurations as scheduled on drawings. Equipment must be listed in UL Elec Equip Dir or ETL DLP for computer room application. CRACs must have a minimum sensible coefficient of performance of 2.10 in accordance with ASHRAE 127. CRACs must include room cabinet and frame, floor stand, fan section, filter section, cooling coil, reheat coil, humidifier, compressors, separate outdoor condenser, and controls, as indicated on the drawings. Provide units rated in accordance with AHRI 1360.

Unless otherwise indicated or scheduled on drawings, provide equipment motor selections that do not exceed 1,800 rpm.

2.1.1 Unit Airflow Configuration

2.1.1.1 In-row Units

The CRAC must be designed and manufactured to be installed within the row of server cabinets where it must draw return air in at the back (from the hot aisle) and discharge supply air at the front (into the cold aisle). In-row units must match the height and depth of the adjacent racks and integrate into the row such that no gaps exist that would allow air to bypass from the cold aisle to the hot aisle.

2.1.2 Cabinet and Frame

2.1.2.1 Unit Frame

Unit frame must be manufactured of welded steel tubes and must be mill-galvanized or coated with an epoxy finish.

2.1.2.2 Unit Cabinet

Exterior panels must be steel sheet, minimum of 20 gage, mill-galvanized or coated with a corrosion-inhibiting epoxy or powder-coat baked finish in manufacturer's standard color. Mill galvanized sheet metal must be coated with not less than 1.25 ounces of zinc per square foot of two-sided surface. Mill rolled structural steel must be hot-dip galvanized or primed and painted. Cut edges, burns and scratches in hot-dip galvanized surfaces must be coated with galvanizing repair coating. Manufacturer's standard cabinet materials and finishes will be acceptable if equivalent to the above requirements and approved by the Contracting Officer.

Provide removable panel for access to controls without interrupting airflow. Panels must be gasketed to prevent air leakage under system operating pressure and must be removable for service access without the use of special tools.

Provide double deflection supply and return grilles integral to unit. Grilles must be factory coated the same as the unit cabinet.

2.1.3 Fan Section

Provide fan(s) and fan motor(s) as integral, factory installed components of the CRAC.

2.1.3.1 Fan Wheel

The supply air fan must be AMCA certified. Provide steel or aluminum, backward curved, plenum/plug type fan wheel. The fan must be statically and dynamically balanced. The fan must have self-aligning, permanently lubricated ball bearings with a minimum life span of 100,000 hours. Assess potential effects of lubricant on aquatic organisms in accordance with ASTM D6081 and submit aquatic toxicity reports. Assess biodegradation in accordance with ASTM D5864. In accordance with EM 1110-2-1424 Chapter 8, aquatic toxicity shall exceed 1,000 ppm at LL50 and biodegradation shall exceed 60 percent conversion of carbon to carbon dioxide in 28 days.

2.1.3.2 Motor and Drive

Provide fan wheel directly coupled to motor shaft.

Provide drip-proof, permanent split capacitor type, NEMA rated motor with inherent overload protection and sliding adjustable motor base.

Provide variable frequency drive(s) in accordance with Section 26 29 23 ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS.

2.1.4 Cooling Coil and Integral Condensate Pump

Provide AHRI 410 coil and slope for drainage. Coil must be manufactured of seamless copper tubes with plate aluminum fins. Indoor and outdoor

coils must be matched and from same manufacturer. Each coil, in the production process, must be individually tested at 320 psi with compressed air under water and verified to be air tight. Factory dehydrate and seal each coil after testing and prior to evaluation and charging. Provide DX coil complete with a distributor and thermostatic expansion valve with external equalizer. Provide double-sloped condensate drain pan of minimum 20 gage Type 304 stainless steel with nonferrous connections, and internal trap,, and a condensate pump system complete with integral pump discharge check valve, integral float switch, reservoir, and pump and motor assembly.

2.1.5 Filters

Provide UL listed 2 inches thick deep pleated fiberglass throwaway type filters. Provide filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 as determined by ASHRAE 52.2. Provide one complete spare filter bank set per unit for installation prior to final acceptance testing covered in Part 3 of this section.

2.1.6 Hot Gas Reheat Coil

Provide AHRI 410 hot gas reheat refrigerant coils for dehumidification control.

Alternative: Provide electric reheat coils with low watts density. The electric reheat coils must be enclosed in 304 stainless steel tubes and 304 stainless steel fins. Provide modulating control of the electric reheat coils by Silicon Controlled Rectifier (SCR). Provide UL or ETL listed safety switches to protect system from overheating.

2.1.7 Humidifier

Humidifier section must include liquid-level control, emergency overflow and automatic water supply system factory pre-piped for final connection. Provide stainless steel evaporator pan with water high level and low level alarms. Provide stainless steel Type 316 dispersion tube assembly. Arrange system to be cleanable and serviceable. Provide water chemistry requirements with humidifier submittal data.

Provide humidifier of the self-contained steam generating electrode type capable of utilizing a potable water connection with full probes connected to electric power via electrode screw connectors. Provide electrodes manufactured from expanded low carbon steel, zinc plated and dynamically formed for precise current control. The humidifier assembly must include integral fill cup, fill and drain valves and associated piping. Design the steam generator to collect and skim the mineral deposits in the water to drain connection and provide clean particle free steam to the air stream.

2.1.8 Compressor

Provide compressor that is direct drive, hermetic digital scroll with variable capacity control type capable of operating at partial load conditions. Compressor must be capable of continuous operation down to the lowest step of unloading as specified. Provide compressors of 7.5 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 each compressor in the unloaded position. Provide compressors complete with vibration isolation, suction and discharge service valves, high and low pressure safety switches, protection against short cycling, and built-in overload protection. Provide refrigeration circuits including hot gas mufflers, liquid-line filter-drier, refrigerant sight glass, and moisture indicator, externally equalized expansion valve, and liquid-line solenoid valve factory connected with refrigeration copper tubing. Crankcase heaters are required.

2.1.8.1 Refrigeration Circuit

Provide field-installed refrigerant tubing for split systems in accordance with Section 23 23 00 REFRIGERANT PIPING.

Refrigerant-containing components must comply with ANSI/ASHRAE 15 & 34 and be factory tested, cleaned, dehydrated, charged with refrigerant and oil 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 control to prevent freeze-up in event of loss of water flow during heating cycle.

2.1.9 Condenser

Provide condenser circuit pre-piped with start-up and head pressure controls to maintain system operation at ambient temperatures down to 0 degrees F. Provide manufacturer's low ambient kit with all necessary accessories and appurtenances.

Provide an integral factory wired and tested control panel for each condenser. The factory control board must control each condenser fan speed individually to optimize overall system performance.

2.1.9.1 Air-cooled Condenser

Provide remote air-cooled condenser arranged for vertical or horizontal air discharge, designed and manufactured specifically for permanent outdoor installation. Condenser performance must be rated in accordance with ANSI/AHRI 460. Condenser must have head pressure control to allow unit operation down to 0 degrees F.

2.1.9.1.1 Condenser Fans

Provide direct-driven propeller fans with factory balanced aluminum blades and equipped with fan guards. Provide electronically commutated fan motors with totally enclosed enclosures.

2.1.9.1.2 Condenser Coils

Air-cooled condenser coils must be seamless copper tubes with plate type aluminum fins with coating as described in paragraph CORROSION PROTECTION FOR COASTAL INSTALLATIONS. The coils, in the production process, must be pressure tested with compressed air at 300 psig under water and verified to be leak-free. Factory dehydrate and seal each coil after testing and prior to evaluation and charging.

2.1.9.1.3 Unit Casing

Provide air-cooled condenser casings and mounting legs manufactured from galvanized steel with coating as described in paragraph CORROSION PROTECTION FOR COASTAL INSTALLATIONS.

2.2 COLD AND HOT AISLE CONTAINMENT SYSTEMS

Provide an engineered and manufactured system of solid panels to fully enclose each hotcold aisle. The system must connect to uniform rows of same-height racks. The containment system must be provided in its entirety from a single manufacturer. All components must be selected for compatibility with the equipment support frame provided under Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM. All materials in the containment system must have a flame spread index not greater than 75 and a smoke developed index not greater than 450 when tested in accordance with ASTM E84 or UL 723.

Wall Panels: 0.236 inch minimum thickness polycarbonate panels framed within 1 inch x 1 inch T-slot aluminum extrusion or extruded aluminum tube. Panels must be UL 94 listed with a minimum rating of V-1.

Roof Panels: Construction same as wall panels.

Doors: Sliding or Hinged doors of similar construction to wall panels. Doors must comply with the requirements of CPSC 16 CFR 1201.

Grommets: At each penetration through the aisle enclosure system, provide brush-type grommets to minimize air leakage. Grommets must be of ABS or polypropylene construction with nylon brush filaments and EPDM gasket.

Blanking Panels: Provide panels to blank off openings in the aisle. Panel construction must be similar to wall panel construction or rack enclosure construction.

2.3 INSTRUMENTATION AND CONTROLS

All controls provided under this section must comply with the requirements of Section Sections 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM.

2.3.1 Unit Level Controls

Provide factory installed components and wiring to control a unit's basic functions and space ambient conditions including humidification and dehumidification at one factory installed and tested station. Controller modules must provide automatic centralized control of computer room critical equipment, simplifying emergency switching and unit testing. When the module recognizes an alarm condition, it must automatically switch to a stand-by device. User must be able to program a switching delay to allow time to correct emergency conditions. Provide modules with capability to balance the runtime of all connected air units. Provide clear, simplified instructions for programming and configuration of controllers, minimizing the chances of operator error. Provide an electronic temperature and humidity recorder, integral or external to the unit, readable to specified control accuracy, complete with supplies required for one year of operation. Controls must include a control system interface to an HVAC control system. The control system interface

must meet DDC Hardware requirements of Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC . Unit controls must comply with the requirements of Sections 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM .

2.3.1.1 Display Panel

Provide color LED touchscreen display with graphical menu navigation or LCD digital display with push button navigation. Display panel must include the following minimum data: power on, power off, unit in alarm, description of alarm, filter status, rack inlet temperature, room temperature, room relative humidity, event log, service contact information, and unit run hours. Display must have capability to set up password protection.

Provide the following minimum externally accessible controls at the unit: start and stop total system functions, silence audible alarm, main power disconnect.

2.3.1.2 Alarms

Display alarms on unit display panel. Alarm for the following: high and low space temperature, high and low space humidity, dirty filters, loss of airflow, compressor high head pressure, custom alarms as indicated on the controls drawings, humidifier problems, and leak detection. Provide field accessible local audible alarm with silence pushbutton. Provide push-to-test lamps or all-lamp test pushbutton. CRACs must have local devices which provide signals for remote audible and visual alarming capability for the above specified alarm conditions.

2.3.1.3 Leak Detection

Provide drip pan below all piping with spot moisture detection system for each computer room. . Leak detection system must interface with the associated CRAC control panel to alarm upon detection of moisture on the subfloor.

2.3.1.4 Factory Wired Components

Provide CRAC manufacturer's remote room temperature sensor, and rack mounted temperature sensor array, and room humidity sensor. Sensors must meet the requirements of Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC.

Provide factory wired discharge air temperature sensor. Sensors must meet the requirements of Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC.

2.3.2 Supervisory CRAC Controls

In addition to stand alone controls, provide devices to network together all CRACs in each computer room. The network device must integrate all data for each CRAC, as required under stand alone controls, and display it on any connected CRAC's display panel. The network device must optimize the operation of all connected CRACs to minimize energy use. The network device must balance runtime across all connected units. The network device must automatically switch to a standby unit upon detection of failure of a duty unit. Provide all control wiring among CRACs and network devices as required to meet this specification.

2.3.3 Integration to HVAC control system

Integrate CRAC control into the HVAC control system defined in Section 23 09 23.02 BACNET DIGITAL CONTROL FOR HVAC AND OTHER BUILDING CONTROL SYSTEMS. HVAC control system interface point is located in DDC control panel as located on drawings.

Refer to controls drawings for minimum points required to interface with the HVAC control system.

2.4 CORROSION PROTECTION

Coat exterior coils, exterior casings, interior coils exposed to outdoor air, and interior casings exposed to outdoor air, in accordance with Section 09 90 00 PAINTS AND COATINGS.

Provide the phenolic finish coating system on exterior coils, exterior casings, interior coils exposed to outdoor air, and interior casings exposed to outdoor air. The coating system must not reduce the HVAC equipment's performance rating.

Finish coating must be applied at the premises of the HVAC equipment manufacturer or at the premises of the coating manufacturer or his authorized applicator. Provide finish coating in colors gray, or aluminum, or ivory. All components of the special finish coating systems, including primers and intermediate coats, must be applied by immersion dip-coating or spray-coating in accordance with coating manufacturer's written procedures.

If special finish coatings are applied at the finish coating manufacturer's (or his authorized applicator's) premises, the equipment to be finish coated must be transported to and from the finish coating manufacturer's premises by the Contractor. The finish-coating manufacturer must be responsible for necessary disassembly of the HVAC equipment and re-assembly of final finish coated equipment.

Submit for approval a Certificate of Specification Compliance provided by the finish coating system manufacturer. Requirements for certificate include:

- a. Name of firm that provided the finish coating system.
- b. Project title and Navy construction contract number.
- c. Listing of the pieces of equipment that were finish coated by this firm.
- d. Certificate must certify that the finish coating materials and application procedures employed conform to the contract specifications.
- e. Date of final inspection by this firm and printed name and signature of the inspector.
- f. Printed name and signature of the officer of the firm that is responsible for firm's certification program.

2.4.1 Phenolic Finish Coating System

Provide a resin base thermosetting phenolic finish.

2.4.1.1 Heat Exchanger Coil (Including Evaporator Coil) Surfaces

- a. Apply phenolic finish to the entire coil. Provide a minimum of two coats. Total minimum dry film thickness must be 3 mils.
- b. In lieu of coating, provide coil of copper tubes and copper fins

2.4.1.2 Uninsulated Interior Surfaces and Exterior Surfaces

Amine cured epoxy phenolic finish: 6 to 7 mils minimum total dry film thickness.

2.4.1.3 Insulated Interior Surfaces

Polyester or Vinyl Ester finish: 2 to 10 mils minimum dry film thickness.

2.5 FACTORY PAINTING SYSTEMS

Provide manufacturer's standard factory painting. Certify that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors must withstand 500 hours in a salt-spray fog test. Salt-spray fog test must be in accordance with ASTM B117, and for that test the acceptance criteria must be as follows: immediately after completion of the test, the paint must show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen must show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment must not be less than the film thickness used on the test specimen. The factory painting system must be designed for the anticipated temperature service.

2.6 ELECTRICAL

Provide an integral electrical panel of similar construction to the unit cabinet. Within the electrical panel, provide a single point power connection terminal block and fused disconnect switch,. The electrical panel must provide at least 65,000 amp Short Circuit Current Rating (SCCR). Refer to electrical drawings for Short Circuit Current Rating (SCCR).

2.6.1 Electrical Motors, Controllers, Contactors, and Disconnects

Provide motors, controllers, disconnects and contactors with their respective pieces of equipment. Motors, controllers, disconnects and contactors must conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors will not be permitted. Controllers and contactors must have a maximum of 120 volt control circuits, and must have auxiliary contacts for use with the controls provided. When motors and equipment provided are larger than sizes indicated, the cost of additional electrical service and related work must be included under the section that specified that motor or equipment.

Power wiring and conduit for field installed equipment must be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.6.2 Electrical Installations

Conform to IEEE C2, NFPA 70, and requirements specified herein.

2.6.2.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters (except starters/controllers which are indicated as part of a motor control center), control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors are not to be permitted. The interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, the motor control equipment forming a part of motor control centers, and the electrical power circuits must be provided under Division 26, except internal wiring for components of package equipment must be provided as an integral part of the equipment. When motors and equipment provided are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

2.6.2.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.

2.6.2.3 High Efficiency Motors

2.6.2.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, single-phase fractional-horsepower alternating-current motors must be high efficiency types corresponding to the applications listed in NEMA MG 11.

2.6.2.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, polyphase motors must be selected based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, polyphase squirrel-cage medium induction motors with continuous ratings must meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

2.6.2.4 Three-Phase Motor Protection

Provide controllers for motors rated 1 horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.6.3 Electrical Control Wiring

Provide control wiring under Section 23 09 00 INSTRUMENTATION AND CONTROL

FOR HVAC. Provide control wiring under this section in accordance with NFPA 70 and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide Space temperature control system drawings which include point-to-point electrical wiring diagrams.

2.7 FIRE PROTECTION DEVICES

The requirements for duct smoke detectors are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

2.8 SOURCE QUALITY CONTROL

Provide factory test plans, factory test schedules, factory tests and factory test reports on each of the CRACs;.

2.8.1 Manufacturer's Factory Test Plans

For each CRAC, submit a factory test plan which when followed during factory testing shall verify that the performance scheduled on the drawings is met by the produced CRAC models.

The manufacturer shall perform factory tests on the actual CRACs produced for this project. The test reports shall document the performance tests conducted on the factory assembled computer room air conditioning units. Performance testing on the individual computer room air conditioning unit components, not factory assembled, is not acceptable.

Submit the required test plans for review and approval to the Contracting Officer at least 90 calendar days before scheduled factory test date.

2.8.1.1 Test Procedure

Indicate in each test plan the factory acceptance test procedures. Procedures shall be structured to test all modes of operation to confirm that the controls are performing in accordance with the intended sequence of control.

Controllers shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

2.8.1.2 Performance Variables

Each test plan shall list performance variables that are required to be measured or tested as part of the field test. Include in the performance variables list the performance indicated on the equipment schedules on the contract design drawings.

Manufacturer must provide with each test procedure a description of acceptable performance results that shall be verified. Manufacturer shall identify the acceptable limits or tolerances within which each tested performance variable shall acceptably operate.

2.8.1.3 Test Configuration

Plans shall indicate that tests are to be performed for a minimum of four continuous hours in a wet coil condition. If test period is interrupted,

the four hour test period shall be started over. Each test plan shall be job specific and shall address the particular CRACs and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

2.8.1.4 Tested Variables

Plans shall provide for air side testing which includes verification of the airflow, total static pressure; fan drive motor KW, amperage and RPM; and fan RPM. Provide entering air temperatures equal to those indicated on the CRAC schedules.

2.8.1.5 Thermal Testing

Plans shall provide thermal testing utilizing temperatures equal to those indicated on the CRAC schedules. Thermal testing shall verify CRAC heating, sensible cooling, total cooling, and humidifying performance scheduled on the contract drawings.

2.8.1.6 Specialized Components

Include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

2.8.1.7 Factory Test For Sound Pressure Level

Determine the A-weighted sound pressure level for the indoor portion of each of the CRACs.

Each unit shall be mounted on a floor duplicating of the installation configuration indicated on the contract drawings. Unit shall be located at least 5 feet 6 inches from test room walls. No other equipment shall be operating in the test room during sound level testing of subject unit. Background sound levels shall be at least 10 dB below lowest sound pressure level measured on subject unit. Testing shall be conducted by using an ANSI Type 1 or 2 sound level meter located 3.3 feet from the unit under test and 3.3 feet above raised floor. Measure and record A-weighted sound pressure level on all four sides of unit.

2.8.1.8 Factory Tests Reporting Forms

Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives. Submit factory test reports, referencing each tested CRAC serial number, and receive approval before delivery of CRAC to the project site.

2.8.2 Factory Tests

Conduct the factory testing in compliance with the Contracting Officer approved manufacturer's field test plan, and in accordance with additional field testing requirements specified herein. Record the required data using the test reporting forms approved of the approved field test plan. Conduct the test for each CRAC for the continuous test period in the approved test plan. A CRAC shutdown before the continuous test period is completed shall result in the test period being started again and run for the required duration.

2.8.3 Deficiency Resolution

The test requirements shall be acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections tested as specified in the paragraph FACTORY TEST PLANS.

2.8.4 Factory Test Reports

Use the test reporting forms approved in the factory test plan. Final test report forms shall be typed including data entries and remarks. Completed test report forms for each CRAC shall be reviewed, approved, and signed by the Manufacturer's test director.

2.9 OZONE DEPLETING SUBSTANCES

Unitary air conditioning equipment must not use CFC-based refrigerants. Refrigerant shall 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.

HVAC systems must follow the regulations of Colorado Regulation 22: Manufacturers/sellers in the State of Colorado of air-conditioning, refrigeration, foam, or aerosol propellant products, must provide a written disclosure to the buyer as part of the sales transaction and invoice or a label on the product or equipment. Refer to <https://www.epa.gov/snap/substitutes-refrigeration-and-air-conditioning> for all prohibited refrigerants and substitutions.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 CRAC System

Installation of each CRAC system including equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing, must be in accordance with ASME B31.1, ASME B31.5, NFPA 70, as modified and supplemented by the requirements of this section and the CRAC manufacturer's written installation instructions.

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.

3.1.2 Installation Instructions

Provide a manufacturer's installation manual for each type of CRAC. Provide a manufacturer's installation manual for each type of aisle containment system.

3.1.3 Operation and Maintenance Data

Submit Computer Room Air Conditioner Operation and Maintenance Data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

3.1.4 Connections to Existing Systems

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Provide materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Provide labor and tools for making actual connections to existing systems.

3.2 FIELD QUALITY CONTROL

Upon completion and before final acceptance of work, test each CRAC subsystem in service to demonstrate compliance with the contract requirements, including field testing specified below. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided and repeat tests. Provide steam, fuel, water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping before placing in operation. Clean equipment, piping, strainers, and ducts. Prior to commencement of field testing, remove all filters and provide new filters. Perform and document that proper Indoor Air Quality During Construction procedures have been followed; this includes providing documentation showing that after construction ends, and prior to occupancy, new filters were provided.

3.3 FIELD TESTING

Provide field test plans, field test schedules, field tests and field test reports on each of the CRACs. Field test each CRAC for Contracting Officer acceptance in accordance with the CRAC manufacturer's approved field test plan.

3.3.1 Manufacturer's Field Test Plans

Submit field test plans developed by the manufacturer for each CRAC; submit the field test plans at least 90 calendar days prior to planned date of the field test. Field test plans developed by the installing Contractor, or the equipment sales agency furnishing the CRAC, will not be acceptable.

The Contracting Officer will review and approve the field test plan for each of the listed CRACs prior to commencement of field testing of the equipment. The approved field test plans must be followed for the field tests of the CRAC and test reporting.

3.3.1.1 Coordinated Testing

Indicate in each field test plan when work required by this section requires coordination with test work required by other specification sections. Provide test procedures for the simultaneous or integrated testing of: CRAC controls which interlock and interface with controls factory prewired; and external controls for the CRAC provided under Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

3.3.1.2 Prerequisite Testing

Each CRAC for which performance testing is dependent upon the completion of the work covered by Section 23 05 93 TESTING, ADJUSTING AND BALANCING

FOR HVAC must have that work completed as a prerequisite to testing work under this section. Indicate in each field test plan when such prerequisite work is required.

3.3.1.3 Test Procedure

Indicate in each field test plan the CRAC manufacturer's published start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

Procedures must be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control.

Controllers must be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

3.3.1.4 Performance Variables

Each test plan must list performance variables that are required to be measured or tested as part of the field test.

Include, in the listed performance variables, requirements indicated on the CRAC schedules on the design drawings. Manufacturer must provide, with each test procedure, a description of acceptable results that have been verified.

Manufacturer must identify the acceptable limits or tolerances within which each tested performance variable must acceptably operate.

3.3.1.5 Test Configuration

Plans must indicate that tests are to be performed for a minimum of four continuous hours in a wet coil condition. If test period is interrupted, the four hour test period must be started over. Each test plan must be job specific and must address the particular CRACs and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

3.3.1.6 Tested Variables

Plans must provide for air side testing which includes verification of the airflow, total static pressure; fan drive motor KW, amperage and RPM; and fan RPM. Provide entering air temperatures equal to those indicated on the CRAC schedules.

3.3.1.7 Thermal Testing

Plans must provide thermal testing utilizing temperatures equal to those indicated on the CRAC schedules. Thermal testing must verify CRAC heating, sensible cooling, total cooling, and humidifying performance scheduled on the contract drawings.

3.3.1.8 Specialized Components

Include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

3.3.1.9 Field Test Reporting Forms

Each test plan must include the required test reporting forms to be completed by the Contractor's testing representatives.

3.3.2 Field Test Schedule

Notify the Contracting Officer in writing at least 30 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for the review and approval of the Contracting Officer.

3.3.3 Manufacturer's Test Representative

Provide a factory trained field test representative authorized by the CRAC manufacturer to oversee the complete execution of the field testing. This test representative must also review, approve, and sign the completed field test report. Signatures must be accompanied by the person's name typed.

Submit credentials of the manufacturer's field test representative proposed, including current telephone number, to the Contracting Officer for review and approval. Submit these credentials with the written advance notice of the field tests.

3.3.4 Field Tests

Conduct the field testing in compliance with the Contracting Officer approved manufacturer's field test plan, and in accordance with additional field testing requirements specified herein. Record the required data using the test reporting forms approved of the approved field test plan. Conduct the test for each CRAC for a continuous 24-hour test period. A CRAC shutdown before the continuous 24-hour test period is completed must result in the 24-hour test period being started again and run for the required duration.

3.3.5 Deficiency Resolution

The test requirements must be acceptably met; deficiencies identified during the tests must be corrected in compliance with the manufacturer's recommendations. Corrections must be tested again in compliance with the requirements specified in the paragraph FIELD TEST PLANS.

3.3.6 Field Test Reports

Use the test reporting forms approved in the field test plan. Final test report forms must be typed, including data entries and remarks. Completed test report forms for each CRAC must be reviewed, approved, and signed by the Contractor's test director and the QC manager.

3.4 INSTRUCTION TO GOVERNMENT PERSONNEL

Provide the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors must be thoroughly familiar with all parts of the installation and must be trained in operating theory as well as practical operation and maintenance work.

Instruction must be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. Provide 4 hours of training for each type of CRAC specified.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 25 - INTEGRATED AUTOMATION

SECTION 25 05 11.21

CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS FIRE AND LIFE SAFETY
SYSTEMS

05/21

PART 1 GENERAL

- 1.1 CONTROL SYSTEM APPLICABILITY
- 1.2 RELATED REQUIREMENTS
- 1.3 REFERENCES
- 1.4 DEFINITIONS
 - 1.4.1 Administrator Account
 - 1.4.2 Computer
 - 1.4.3 Controller
 - 1.4.4 Mission Space
 - 1.4.5 Network
 - 1.4.6 Network Connected
 - 1.4.6.1 Wireless Network Connected
 - 1.4.7 Network Media
 - 1.4.8 User Account Support Levels
 - 1.4.8.1 FULLY Supported
 - 1.4.8.2 MINIMALLY Supported
 - 1.4.8.3 NOT Supported
 - 1.4.9 Manual Local Input
 - 1.4.10 Card Reader
 - 1.4.11 User Interface
 - 1.4.11.1 Local User Interface
 - 1.4.11.2 Remote User Interface
 - 1.4.11.3 Types of User Interface (by capability)
 - 1.4.11.3.1 Read-Only User Interface
 - 1.4.11.3.2 Limited User Interface
 - 1.4.11.3.3 Full User Interface
 - 1.4.11.3.4 View-Only User Interface
 - 1.4.11.4 Other User Interface Terminology
 - 1.4.11.4.1 Writable User Interface
 - 1.4.11.4.2 Privileged User Interface
 - 1.4.12 Wireless Network
 - 1.4.13 Wired Broadcast Network
- 1.5 ADMINISTRATIVE REQUIREMENTS
 - 1.5.1 Points of Contact
 - 1.5.2 Coordination
- 1.6 SUBMITTALS
- 1.7 QUALITY CONTROL
 - 1.7.1 Qualifications
 - 1.7.2 Cybersecurity Subject Matter Expert Qualifications
- 1.8 CYBERSECURITY DOCUMENTATION
 - 1.8.1 Network Communication Report
 - 1.8.2 Control System Inventory Report
 - 1.8.3 Software and Configuration Backups
 - 1.8.4 Cybersecurity Riser Diagram

- 1.8.5 Vendor Guide Compliance Result Report
- 1.8.6 Control System Cybersecurity Documentation
 - 1.8.6.1 Default Requirements for Control System Devices
- 1.9 SOFTWARE LICENSING
- 1.10 CYBERSECURITY DURING CONSTRUCTION
 - 1.10.1 Contractor Computer Equipment
 - 1.10.1.1 Operating System
 - 1.10.1.2 Anti-Malware Software
 - 1.10.1.3 Passwords and Passphrases
 - 1.10.1.4 User-Based Authentication
 - 1.10.1.5 Demonstration of Compliance
 - 1.10.1.6 Contractor Computer Cybersecurity Compliance Statements
 - 1.10.2 Temporary IP Networks
 - 1.10.2.1 Network Boundaries and Connections
 - 1.10.3 Government Access to Network
 - 1.10.4 Temporary Wireless IP Networks
 - 1.10.5 Passwords and Passphrases
 - 1.10.6 Contractor Temporary Network Cybersecurity Compliance Statements
- 1.11 CYBERSECURITY DURING WARRANTY PERIOD

PART 2 PRODUCTS

PART 3 EXECUTION

- 3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES
- 3.2 NETWORK REQUIREMENTS
 - 3.2.1 Information Flow Enforcement In MODERATE Impact Systems
 - 3.2.2 Wireless and Wired Broadcast Communication for Fire Protection Systems
 - 3.2.3 Non-IP Control Networks
 - 3.2.4 IP Control Networks
 - 3.2.4.1 IP Network Routers
 - 3.2.5 Cryptographic Protection
 - 3.2.6 Device Identification and Authentication
 - 3.2.6.1 Default Requirements for Control System Devices
 - 3.2.7 Cryptographic Module Authentication
- 3.3 ACCESS CONTROL REQUIREMENTS
 - 3.3.1 User Accounts
 - 3.3.1.1 Controllers
 - 3.3.1.1.1 Fire Protection Systems
 - 3.3.1.2 Additional User Account Expiration Requirements In MODERATE Impact Systems:
 - 3.3.1.2.1 For Control System Applications Running on Computers
 - 3.3.1.2.2 For Other Control System Devices FULLY Supporting Accounts
 - 3.3.2 Unsuccessful Logon Attempts
 - 3.3.2.1 Devices MINIMALLY Supporting Accounts
 - 3.3.2.2 Devices FULLY Supporting Accounts
 - 3.3.3 System Use Notification
 - 3.3.3.1 System Use Notification for Remote User Interfaces
 - 3.3.3.2 System Use Notification for Local User Interfaces
 - 3.3.4 Session Lock and Session Termination Requirements In MODERATE Impact Systems:
 - 3.3.4.1 Session Termination
 - 3.3.4.2 Session Lock
 - 3.3.4.3 Session Lock and Termination for Controllers
 - 3.3.5 Permitted Actions Without Identification or Authentication

- 3.3.6 Physical Security in MODERATE Impact Systems
 - 3.3.6.1 Physical Security for Media
 - 3.3.6.1.1 Physical Security for Media Inside Mission Space
 - 3.3.6.1.2 Physical Security for Media Outside Mission Space
 - 3.3.6.1.3 Physical Security for Non-Network Media in Fire Protection Systems
 - 3.3.6.2 Physical Security for Devices
 - 3.3.6.2.1 Physical Security for Devices in Fire Protection Systems
 - 3.3.6.3 Physical Security for User Interfaces
- 3.3.7 Enclosures
- 3.4 USER IDENTIFICATION AND AUTHENTICATION
 - 3.4.1 User Identification and Authentication for All System Types
 - 3.4.2 User Identification and Authentication for Specific System Types
 - 3.4.3 User Identification and Authentication for Specific Devices
 - 3.4.4 Implementation of Identification and Authorization Requirements
 - 3.4.5 Password-Based Authentication Requirements
 - 3.4.5.1 Passwords for Controllers FULLY Supporting Accounts
 - 3.4.5.2 Passwords for Remote Interfaces
 - 3.4.5.3 Passwords for Devices Minimally Supporting Accounts
 - 3.4.5.4 Password Configuration and Reporting
 - 3.4.6 Authenticator Feedback
- 3.5 CYBERSECURITY AUDITING
 - 3.5.1 Audit Events, Content of Audit Records, and Audit Generation
 - 3.5.1.1 Default Requirements for Control System Controllers
 - 3.5.1.1.1 Controllers Which FULLY Support Accounts
 - 3.5.1.1.1.1 Audited Events
 - 3.5.1.1.1.2 Audit Event Information To Record
 - 3.5.1.1.2 Controllers Which Do Not FULLY Support Accounts
 - 3.5.2 Audit Time Stamps
 - 3.5.3 Auditing Front End Software
 - 3.5.3.1 Import and Upload Requirements
 - 3.5.3.2 Export Requirements
 - 3.5.3.3 Notification Of Audit Failure in Devices in MODERATE Impact Systems
 - 3.5.3.4 Audit Reduction and Report Generation In MODERATE Impact Systems
 - 3.5.4 Audit Storage Capacity and Audit Upload
 - 3.5.4.1 Audit Log Storage Notification In MODERATE Impact Systems
 - 3.5.4.2 Device Audit Record Upload Software
 - 3.5.5 Response to Audit Processing Failures
- 3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY
 - 3.6.1 Device Capabilities
 - 3.6.2 Software
- 3.7 SYSTEM AND COMMUNICATION PROTECTION
 - 3.7.1 Collaborative Computing
 - 3.7.2 Denial of Service Protection and Application Partitioning In MODERATE Impact Systems:
 - 3.7.2.1 Default Requirements for MODERATE Impact Control Systems
 - 3.7.3 Process Isolation and Boundary Protection in Moderate Impact Fire Protection Systems
 - 3.7.3.1 Radio Interfaces for Fire Protection Systems
- 3.8 SAFE MODE AND FAIL SAFE OPERATION
- 3.9 SYSTEM MAINTENANCE TOOL SOFTWARE
- 3.10 DEVICE POWER
 - 3.10.1 Device Behavior on Loss of Power In MODERATE Impact Systems:
- 3.11 VULNERABILITY SCANNING
 - 3.11.1 Controllers

3.12 SYSTEM AND INTEGRATION INTEGRITY

3.12.1 Software, Firmware, and Information Integrity In MODERATE
Impact Systems:

3.13 CONTROL SYSTEM CYBERSECURITY TESTING

3.13.1 Control System Cybersecurity Testing Procedures

3.13.2 Control System Cybersecurity Testing Execution

3.13.3 Control System Cybersecurity Testing Report

3.14 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT

3.15 CYBERSECURITY TRAINING

-- End of Section Table of Contents --

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 <http://iase.disa.mil/stigs/Pages/index.aspx>. 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 FIRE ALARM AND MASS NOTIFICATION SYSTEM, 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)

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. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.
- g. Passwords must be coordinated with the indicated contact for the project site.
- h. If applicable, HTTPS web server certificates must be obtained from the indicated HTTPS Certificate Point of Contact.
- i. 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 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

Wireless and Wired Broadcast Communication Request; G

Device Account Lock Exception Request; G

Contractor Computer Cybersecurity Compliance Statements; G

Contractor Temporary Network Cybersecurity Compliance Statements; G

Cybersecurity Subject Matter Expert Qualifications

SD-02 Shop Drawings

Network Communication Report; G

Cybersecurity Riser Diagram; G

SD-03 Product Data

Control System Cybersecurity Documentation; G

SD-06 Test Reports

Wireless Communication Test Report; G

Control System Cybersecurity Testing Procedures; G

Control System Cybersecurity Testing Report; G

SD-07 Certificates

Software Licenses; G

SD-11 Closeout Submittals

Password Change Summary Report; G

Enclosure Keys; G

Software and Configuration Backups; G

Auditing Front End Software; G

Device Audit Record Upload Software; G

System Maintenance Tool Software; G

Vendor Guide Compliance Result Report; G

Control System Inventory Report; G

Integrity Verification Software; G

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, in support of DoD 8140.01, Cyberspace Workforce Management Program.

Individuals for this position must have previous experience securing DoD systems and with the Risk Management Framework.

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 required 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	
<u>User Interface Type</u>	<u>Access Control Requirement</u> (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: 1)Local Read Only User Interfaces are always Non-Privileged 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 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 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 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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 25 - INTEGRATED AUTOMATION

SECTION 25 05 11.23

CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND
CONTROL SYSTEM

05/21

PART 1 GENERAL

- 1.1 CONTROL SYSTEM APPLICABILITY
- 1.2 RELATED REQUIREMENTS
- 1.3 REFERENCES
- 1.4 DEFINITIONS
 - 1.4.1 Administrator Account
 - 1.4.2 Computer
 - 1.4.3 Controller
 - 1.4.4 Mission Space
 - 1.4.5 Network
 - 1.4.6 Network Connected
 - 1.4.6.1 Wireless Network Connected
 - 1.4.7 Network Media
 - 1.4.8 User Account Support Levels
 - 1.4.8.1 FULLY Supported
 - 1.4.8.2 MINIMALLY Supported
 - 1.4.8.3 NOT Supported
 - 1.4.9 Manual Local Input
 - 1.4.10 Card Reader
 - 1.4.11 User Interface
 - 1.4.11.1 Local User Interface
 - 1.4.11.2 Remote User Interface
 - 1.4.11.3 Types of User Interface (by capability)
 - 1.4.11.3.1 Read-Only User Interface
 - 1.4.11.3.2 Limited User Interface
 - 1.4.11.3.3 Full User Interface
 - 1.4.11.3.4 View-Only User Interface
 - 1.4.11.4 Other User Interface Terminology
 - 1.4.11.4.1 Writable User Interface
 - 1.4.11.4.2 Privileged User Interface
 - 1.4.12 Wireless Network
 - 1.4.13 Wired Broadcast Network
- 1.5 ADMINISTRATIVE REQUIREMENTS
 - 1.5.1 Points of Contact
 - 1.5.2 Coordination
- 1.6 SUBMITTALS
- 1.7 QUALITY CONTROL
 - 1.7.1 Qualifications
 - 1.7.2 Cybersecurity Subject Matter Expert Qualifications
- 1.8 CYBERSECURITY DOCUMENTATION
 - 1.8.1 Proposed STIG and SRG Applicability Report
 - 1.8.2 Cybersecurity Interconnection Schedule
 - 1.8.3 Network Communication Report
 - 1.8.4 Control System Inventory Report

- 1.8.5 Software and Configuration Backups
- 1.8.6 Cybersecurity Riser Diagram
- 1.8.7 STIG, SRG and Vendor Guide Compliance Result Report
- 1.8.8 Control System Cybersecurity Documentation
 - 1.8.8.1 Software Applications
 - 1.8.8.2 For HVAC Control System Devices
 - 1.8.8.2.1 HVAC Control System Devices FULLY Supporting User Accounts
 - 1.8.8.2.2 All Other HVAC Control System Devices
 - 1.8.8.3 Default Requirements for Control System Devices
- 1.9 SOFTWARE LICENSING
- 1.10 CYBERSECURITY DURING CONSTRUCTION
 - 1.10.1 Contractor Computer Equipment
 - 1.10.1.1 Operating System
 - 1.10.1.2 Anti-Malware Software
 - 1.10.1.3 Passwords and Passphrases
 - 1.10.1.4 User-Based Authentication
 - 1.10.1.5 Demonstration of Compliance
 - 1.10.1.6 Contractor Computer Cybersecurity Compliance Statements
 - 1.10.2 Temporary IP Networks
 - 1.10.2.1 Network Boundaries and Connections
 - 1.10.3 Government Access to Network
 - 1.10.4 Temporary Wireless IP Networks
 - 1.10.5 Passwords and Passphrases
 - 1.10.6 Contractor Temporary Network Cybersecurity Compliance Statements
- 1.11 CYBERSECURITY DURING WARRANTY PERIOD

PART 2 PRODUCTS

- 2.1 ETHERNET SWITCH
 - 2.1.1 Required Functionality
 - 2.1.2 Configuration Requirements
- 2.2 DAISY CHAIN IP CONTROLLERS

PART 3 EXECUTION

- 3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES
- 3.2 NETWORK REQUIREMENTS
 - 3.2.1 Wireless and Wired Broadcast Communication
 - 3.2.2 Non-IP Control Networks
 - 3.2.3 IP Control Networks
 - 3.2.3.1 IP Network Routers
 - 3.2.3.2 IP Devices With Multiple Ethernet Connection
 - 3.2.4 Cryptographic Protection
 - 3.2.5 Device Identification and Authentication
 - 3.2.5.1 For HVAC Control System Devices
 - 3.2.5.2 Default Requirements for Control System Devices
 - 3.2.6 Cryptographic Module Authentication
- 3.3 ACCESS CONTROL REQUIREMENTS
 - 3.3.1 User Accounts
 - 3.3.1.1 Computers
 - 3.3.1.2 Controllers
 - 3.3.1.2.1 HVAC Control Systems
 - 3.3.2 Unsuccessful Logon Attempts
 - 3.3.2.1 Devices MINIMALLY Supporting Accounts
 - 3.3.2.2 Devices FULLY Supporting Accounts
 - 3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

- 3.3.3 System Use Notification
 - 3.3.3.1 System Use Notification for Remote User Interfaces
 - 3.3.3.2 System Use Notification for Local User Interfaces
- 3.3.4 Permitted Actions Without Identification or Authentication
- 3.3.5 Enclosures
- 3.4 USER IDENTIFICATION AND AUTHENTICATION
 - 3.4.1 User Identification and Authentication for All System Types
 - 3.4.2 User Identification and Authentication for Specific System Types
 - 3.4.2.1 HVAC Control Systems Devices
 - 3.4.3 User Identification and Authentication for Specific Devices
 - 3.4.4 Implementation of Identification and Authorization Requirements
 - 3.4.5 Password-Based Authentication Requirements
 - 3.4.5.1 Passwords for Software and Applications Running on Computers
 - 3.4.5.2 Passwords for Controllers FULLY Supporting Accounts
 - 3.4.5.3 Passwords for Remote Interfaces
 - 3.4.5.4 Passwords for Devices Minimally Supporting Accounts
 - 3.4.5.5 Password Configuration and Reporting
 - 3.4.6 Authenticator Feedback
- 3.5 CYBERSECURITY AUDITING
 - 3.5.1 Audit Events, Content of Audit Records, and Audit Generation
 - 3.5.1.1 Computers
 - 3.5.1.1.1 Audited Events
 - 3.5.1.1.2 Audit Event Information To Record
 - 3.5.1.2 For HVAC Control System Controllers
 - 3.5.1.2.1 HVAC Control System Controllers FULLY Supporting User Accounts
 - 3.5.1.2.1.1 Audited Events
 - 3.5.1.2.1.2 Audit Event Information To Record
 - 3.5.1.2.2 Other HVAC Control System Controllers
 - 3.5.1.3 Default Requirements for Control System Controllers
 - 3.5.1.3.1 Controllers Which FULLY Support Accounts
 - 3.5.1.3.1.1 Audited Events
 - 3.5.1.3.1.2 Audit Event Information To Record
 - 3.5.1.3.2 Controllers Which Do Not FULLY Support Accounts
 - 3.5.2 Audit Time Stamps
 - 3.5.3 Auditing Front End Software
 - 3.5.3.1 Import and Upload Requirements
 - 3.5.3.2 Export Requirements
 - 3.5.4 Audit Storage Capacity and Audit Upload
 - 3.5.4.1 Device Audit Record Upload Software
 - 3.5.5 Response to Audit Processing Failures
- 3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY
 - 3.6.1 Device Capabilities
 - 3.6.2 Software
- 3.7 SYSTEM AND COMMUNICATION PROTECTION
 - 3.7.1 Collaborative Computing
 - 3.7.2 Denial of Service Protection
- 3.8 SAFE MODE AND FAIL SAFE OPERATION
- 3.9 SYSTEM MAINTENANCE TOOL SOFTWARE
- 3.10 DEVICE POWER
- 3.11 VULNERABILITY SCANNING
 - 3.11.1 Computers and Software Running on Computers
 - 3.11.2 Controllers
- 3.12 FIPS 201-2 REQUIREMENT
- 3.13 SYSTEM AND INTEGRATION INTEGRITY
 - 3.13.1 Malicious Code Protection
- 3.14 CONTROL SYSTEM CYBERSECURITY TESTING

- 3.14.1 Control System Cybersecurity Testing Procedures
- 3.14.2 Control System Cybersecurity Testing Execution
- 3.14.3 Control System Cybersecurity Testing Report
- 3.15 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT
- 3.16 CYBERSECURITY TRAINING

-- End of Section Table of Contents --

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 <http://iase.disa.mil/stigs/Pages/index.aspx>. 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 and Advanced Metering.

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 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.

Note that the facility HVAC control system must connect to and integrate

with existing Delta Control systems EMCS front end. In addition, utility metering for the facility is subject to existing AMRS requirements. Metering specifications must be assessed to ensure compatibility with existing AMRS platform. 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.

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

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)

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 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

Device Account Lock Exception Request; G
Multiple Ethernet Connection Device Request; G
Contractor Computer Cybersecurity Compliance Statements; G
Contractor Temporary Network Cybersecurity Compliance Statements; G
Cybersecurity Interconnection Schedule; G
Cybersecurity Subject Matter Expert Qualifications
Proposed STIG and SRG Applicability Report; G

SD-02 Shop Drawings

Network Communication Report; G
Cybersecurity Riser Diagram; G

SD-03 Product Data

Control System Cybersecurity Documentation; G

SD-06 Test Reports

Control System Cybersecurity Testing Procedures; G
Control System Cybersecurity Testing Report; G

SD-07 Certificates

Software Licenses; G

SD-11 Closeout Submittals

Password Change Summary Report; G
Enclosure Keys; G
Software and Configuration Backups; G
Auditing Front End Software; G
Device Audit Record Upload Software; G
System Maintenance Tool Software; G
Control System Scanning Tools; G
STIG, SRG and Vendor Guide Compliance Result Report; G
Control System Inventory Report; G

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, in support of DoD 8140.01, Cyberspace Workforce Management Program.

Individuals for this position must have previous experience administering and securing DoD systems, in addition to applying the Risk Management Framework.

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 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 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	
<u>User Interface Type</u>	<u>Access Control Requirement</u>
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: 1)Local Read Only User Interfaces are always Non-Privileged 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.

3.4.3 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 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:

3.5.1.3.1 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.

3.5.1.3.1.1 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

3.5.1.3.1.2 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

3.5.1.3.2 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.

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 --

SECTION TABLE OF CONTENTS

DIVISION 25 - INTEGRATED AUTOMATION

SECTION 25 05 11.28

CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS - ELECTRONIC SECURITY SYSTEMS

05/21

PART 1 GENERAL

- 1.1 CONTROL SYSTEM APPLICABILITY
- 1.2 RELATED REQUIREMENTS
- 1.3 REFERENCES
- 1.4 DEFINITIONS
 - 1.4.1 Administrator Account
 - 1.4.2 Computer
 - 1.4.3 Controller
 - 1.4.4 Mission Space
 - 1.4.5 Network
 - 1.4.6 Network Connected
 - 1.4.6.1 Wireless Network Connected
 - 1.4.7 Network Media
 - 1.4.8 User Account Support Levels
 - 1.4.8.1 FULLY Supported
 - 1.4.8.2 MINIMALLY Supported
 - 1.4.8.3 NOT Supported
 - 1.4.9 Manual Local Input
 - 1.4.10 Card Reader
 - 1.4.11 User Interface
 - 1.4.11.1 Local User Interface
 - 1.4.11.2 Remote User Interface
 - 1.4.11.3 Types of User Interface (by capability)
 - 1.4.11.3.1 Read-Only User Interface
 - 1.4.11.3.2 Limited User Interface
 - 1.4.11.3.3 Full User Interface
 - 1.4.11.3.4 View-Only User Interface
 - 1.4.11.4 Other User Interface Terminology
 - 1.4.11.4.1 Writable User Interface
 - 1.4.11.4.2 Privileged User Interface
 - 1.4.12 Wireless Network
 - 1.4.13 Wired Broadcast Network
- 1.5 ADMINISTRATIVE REQUIREMENTS
 - 1.5.1 Points of Contact
 - 1.5.2 Coordination
- 1.6 SUBMITTALS
- 1.7 QUALITY CONTROL
 - 1.7.1 Qualifications
 - 1.7.2 Cybersecurity Subject Matter Expert Qualifications
- 1.8 CYBERSECURITY DOCUMENTATION
 - 1.8.1 Proposed STIG and SRG Applicability Report
 - 1.8.2 Cybersecurity Interconnection Schedule
 - 1.8.3 Network Communication Report
 - 1.8.4 Control System Inventory Report

- 1.8.5 Software and Configuration Backups
 - 1.8.6 Cybersecurity Riser Diagram
 - 1.8.7 STIG, SRG and Vendor Guide Compliance Result Report
 - 1.8.8 Control System Cybersecurity Documentation
 - 1.8.8.1 Software Applications
 - 1.9 SOFTWARE LICENSING
 - 1.10 CYBERSECURITY DURING CONSTRUCTION
 - 1.10.1 Contractor Computer Equipment
 - 1.10.1.1 Operating System
 - 1.10.1.2 Anti-Malware Software
 - 1.10.1.3 Passwords and Passphrases
 - 1.10.1.4 User-Based Authentication
 - 1.10.1.5 Demonstration of Compliance
 - 1.10.1.6 Contractor Computer Cybersecurity Compliance Statements
 - 1.10.2 Temporary IP Networks
 - 1.10.2.1 Network Boundaries and Connections
 - 1.10.3 Government Access to Network
 - 1.10.4 Temporary Wireless IP Networks
 - 1.10.5 Passwords and Passphrases
 - 1.10.6 Contractor Temporary Network Cybersecurity Compliance Statements
 - 1.11 CYBERSECURITY DURING WARRANTY PERIOD
- PART 2 PRODUCTS
- 2.1 ETHERNET SWITCH
 - 2.1.1 Required Functionality
 - 2.1.2 Configuration Requirements
 - 2.2 DAISY CHAIN IP CONTROLLERS
- PART 3 EXECUTION
- 3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES
 - 3.2 NETWORK REQUIREMENTS
 - 3.2.1 Information Flow Enforcement In MODERATE Impact Systems
 - 3.2.2 Wireless and Wired Broadcast Communication
 - 3.2.3 Non-IP Control Networks
 - 3.2.4 IP Control Networks
 - 3.2.4.1 IP Network Routers
 - 3.2.4.2 IP Devices With Multiple Ethernet Connection
 - 3.2.5 Cryptographic Protection
 - 3.2.6 Device Identification and Authentication
 - 3.2.7 Cryptographic Module Authentication
 - 3.3 ACCESS CONTROL REQUIREMENTS
 - 3.3.1 User Accounts
 - 3.3.1.1 Computers
 - 3.3.1.2 Controllers
 - 3.3.1.3 Additional User Account Expiration Requirements In MODERATE Impact Systems:
 - 3.3.1.3.1 For Control System Applications Running on Computers
 - 3.3.1.3.2 For Other Control System Devices FULLY Supporting Accounts
 - 3.3.2 Unsuccessful Logon Attempts
 - 3.3.2.1 Devices MINIMALLY Supporting Accounts
 - 3.3.2.2 Devices FULLY Supporting Accounts
 - 3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements
 - 3.3.3 System Use Notification
 - 3.3.3.1 System Use Notification for Remote User Interfaces

- 3.3.3.2 System Use Notification for Local User Interfaces
- 3.3.4 Session Lock and Session Termination Requirements In MODERATE Impact Systems:
 - 3.3.4.1 Session Termination
 - 3.3.4.2 Session Lock
 - 3.3.4.3 Session Lock and Termination for Computers
 - 3.3.4.4 Session Lock and Termination for Controllers
- 3.3.5 Permitted Actions Without Identification or Authentication
- 3.3.6 Physical Security in MODERATE Impact Systems
 - 3.3.6.1 Physical Security for Media
 - 3.3.6.1.1 Physical Security for Media Inside Mission Space
 - 3.3.6.1.2 Physical Security for Media Outside Mission Space
 - 3.3.6.2 Physical Security for Devices
 - 3.3.6.3 Physical Security for User Interfaces
- 3.3.7 Enclosures
- 3.4 USER IDENTIFICATION AND AUTHENTICATION
 - 3.4.1 User Identification and Authentication for All System Types
 - 3.4.2 User Identification and Authentication for Specific System Types
 - 3.4.2.1 Electronic Security System Devices
 - 3.4.3 User Identification and Authentication for Specific Devices
 - 3.4.4 Implementation of Identification and Authorization Requirements
 - 3.4.5 Password-Based Authentication Requirements
 - 3.4.5.1 Passwords for Software and Applications Running on Computers
 - 3.4.5.2 Passwords for Controllers FULLY Supporting Accounts
 - 3.4.5.3 Passwords for Remote Interfaces
 - 3.4.5.4 Passwords for Devices Minimally Supporting Accounts
 - 3.4.5.5 Password Configuration and Reporting
 - 3.4.6 Authenticator Feedback
 - 3.4.7 Implementation of PKI Infrastructure in MODERATE Impact Systems
- 3.5 CYBERSECURITY AUDITING
 - 3.5.1 Audit Events, Content of Audit Records, and Audit Generation
 - 3.5.1.1 Computers
 - 3.5.1.1.1 Audited Events
 - 3.5.1.1.2 Audit Event Information To Record
 - 3.5.1.2 Default Requirements for Control System Controllers
 - 3.5.1.2.1 Controllers Which FULLY Support Accounts
 - 3.5.1.2.1.1 Audited Events
 - 3.5.1.2.1.2 Audit Event Information To Record
 - 3.5.1.2.2 Controllers Which Do Not FULLY Support Accounts
 - 3.5.2 Audit Time Stamps
 - 3.5.3 Auditing Front End Software
 - 3.5.3.1 Import and Upload Requirements
 - 3.5.3.2 Export Requirements
 - 3.5.3.3 Notification Of Audit Failure in Devices in MODERATE Impact Systems
 - 3.5.3.4 Audit Reduction and Report Generation In MODERATE Impact Systems
 - 3.5.4 Audit Storage Capacity and Audit Upload
 - 3.5.4.1 Device Audit Record Upload Software
 - 3.5.5 Response to Audit Processing Failures
- 3.6 REQUIREMENTS FOR LEAST FUNCTIONALITY
 - 3.6.1 Device Capabilities
 - 3.6.2 Software
- 3.7 SYSTEM AND COMMUNICATION PROTECTION
 - 3.7.1 Collaborative Computing
 - 3.7.2 Denial of Service Protection and Application Partitioning In MODERATE Impact Systems:

- 3.7.2.1 Default Requirements for MODERATE Impact Control Systems
- 3.7.3 Mobile Code In MODERATE Impact Systems:
- 3.7.4 Protection of Information at Rest In MODERATE Impact Systems:
- 3.8 SAFE MODE AND FAIL SAFE OPERATION
- 3.9 SYSTEM MAINTENANCE TOOL SOFTWARE
- 3.10 DEVICE POWER
 - 3.10.1 Device Behavior on Loss of Power In MODERATE Impact Systems:
- 3.11 VULNERABILITY SCANNING
 - 3.11.1 Computers and Software Running on Computers
 - 3.11.2 Controllers
- 3.12 FIPS 201-2 REQUIREMENT
- 3.13 SYSTEM AND INTEGRATION INTEGRITY
 - 3.13.1 Malicious Code Protection
 - 3.13.2 Software, Firmware, and Information Integrity In MODERATE Impact Systems:
- 3.14 CONTROL SYSTEM CYBERSECURITY TESTING
- 3.15 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT
- 3.16 CYBERSECURITY TRAINING

-- End of Section Table of Contents --

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 to include Access Control, Intrusion Detection, and CCTV.

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 SYSTEMS, 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)

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" 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

Device Account Lock Exception Request; G
Multiple Ethernet Connection Device Request; G
Contractor Computer Cybersecurity Compliance Statements; G
Cybersecurity Subject Matter Expert Qualifications; G
Contractor Temporary Network Cybersecurity Compliance Statements; G
Cybersecurity Interconnection Schedule; G
Protection of Information At Rest Proposal; G
Proposed STIG And SRG Applicability Report; G

SD-02 Shop Drawings

Network Communication Report; G
Cybersecurity Riser Diagram; G

SD-03 Product Data

Control System Cybersecurity Documentation; G

SD-07 Certificates

Software Licenses; G

SD-11 Closeout Submittals

Password Change Summary Report; G
Enclosure Keys; G
Software and Configuration Backups; G
Auditing Front End Software; G
Device Audit Record Upload Software; G
System Maintenance Tool Software; G
Control System Scanning Tools; G
STIG, SRG and Vendor Guide Compliance Result Report; G
Control System Inventory Report; G
Integrity Verification Software; G

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, in support of DoD 8140.01, Cyberspace Workforce Management Program.

Individuals for this position must have previous experience securing DoD systems, in addition to experience applying the Risk Management Framework.

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 modified 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 required 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 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.

3.3.6.2 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 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: 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 installation 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.

3.5.3.3 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 --

SECTION TABLE OF CONTENTS

DIVISION 25 - INTEGRATED AUTOMATION

SECTION 25 10 10

UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION

02/19, CHG 1: 05/21

PART 1 GENERAL

1.1 SUMMARY

1.1.1 System Requirements

1.1.1.1 General System Requirements

1.1.1.2 BACnet Requirements

1.1.2 General Cybersecurity Requirements

1.1.3 Symbols, Definition and Abbreviations

1.1.4 System Units and Accuracy

1.1.5 Data Packages/Submittals Requirements

1.2 RELATED SECTIONS

1.3 REFERENCES

1.4 DEFINITIONS

1.4.1 Alarm Generation

1.4.2 Alarm Handling

1.4.3 Alarm Routing

1.4.4 BACnet (BACnet)

1.4.5 BACnet Advanced Application Controller (B-AAC)(BACnet)

1.4.6 BACnet Advanced Operator Workstation (B-AWS)(BACnet)

1.4.7 BACnet Application Specific Controller (B-ASC)(BACnet)

1.4.8 BACnet Building Controller (B-BC)(BACnet)

1.4.9 BACnet Internetwork (BACnet)

1.4.10 BACnet Interoperability Building Blocks (BIBBs) (BACnet)

1.4.11 BACnet Operator Display (B-OD)(BACnet)

1.4.12 BACnet Operator Workstation (B-OWS)(BACnet)

1.4.13 BACnet Smart Actuator (B-SA)(BACnet)

1.4.14 BACnet Smart Sensor (B-SS)(BACnet)

1.4.15 BACnet Testing Laboratories (BTL)(BACnet)

1.4.16 BACnet Testing Laboratories (BTL) Listed (BACnet)

1.4.17 Binary

1.4.18 Broadcast

1.4.19 Building Control Network (BCN)

1.4.20 Building Control System (BCS)

1.4.21 Building Point of Connection (BPOC)

1.4.22 Commandable (BACnet)

1.4.23 Control Logic Diagram

1.4.24 Device Object (BACnet)

1.4.25 Field Point Of Connection (FPOC)

1.4.26 Field Control Network

1.4.27 Field Control System (FCS)

1.4.28 Gateway

1.4.29 Internetwork (BACnet)

1.4.30 Modbus

1.4.31 Master-Slave/Token Passing (MS/TP)(BACnet)

1.4.32 Monitoring and Control (M&C) Software

1.4.33 Network (BACnet)

- 1.4.34 Object (BACnet)
- 1.4.35 Override
- 1.4.36 Point, Calculated
- 1.4.37 Point, Network
- 1.4.38 Polling
- 1.4.39 Property (BACnet)
- 1.4.40 Protocol Implementation Conformance Statement (PICS)(BACnet)
- 1.4.41 Repeater
- 1.4.42 Router (BACnet)
- 1.4.43 Segment
- 1.4.44 Service (BACnet)
- 1.4.45 Standard BACnet Object/Property/Service (BACnet)
- 1.4.46 Supervisory Controller
- 1.4.47 Supervisory Gateway
- 1.4.48 UMCS Network
- 1.4.49 Utility Control System (UCS)
- 1.5 SUBMITTALS
- 1.6 PROJECT SEQUENCING
 - 1.6.1 Sequencing for Submittals
 - 1.6.2 Sequencing for Activities
 - 1.6.3 Abbreviations
- 1.7 QUALITY CONTROL (QC) CHECKLISTS
- 1.8 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

PART 2 PRODUCTS

- 2.1 EQUIPMENT REQUIREMENTS
 - 2.1.1 Product Certifications
 - 2.1.2 Product Sourcing
 - 2.1.3 General Requirements
 - 2.1.4 Nameplates
 - 2.1.5 Product Data Sheets
- 2.2 CONTROL HARDWARE
 - 2.2.1 Control Protocol Routers
 - 2.2.1.1 BACnet/IP Router
 - 2.2.2 Monitoring and Control (M&C) Controller Hardware
 - 2.2.3 BACnet Supervisory Controller Hardware
 - 2.2.4 Control Protocol Gateways
 - 2.2.4.1 Gateway for ASHRAE 135
- 2.3 COMPUTER HARDWARE
 - 2.3.1 Server Hardware
 - 2.3.2 Workstation Hardware (Desktop and Laptop)
 - 2.3.2.1 Processor
 - 2.3.2.1.1 Desktop
 - 2.3.2.2 Random Access Memory (RAM)
 - 2.3.2.3 Communications Ports
 - 2.3.2.3.1 Desktop
 - 2.3.2.4 Hard Drive and Controller
 - 2.3.2.4.1 Desktop
 - 2.3.2.4.2 External Hard Drive
 - 2.3.2.5 Optical Drive
 - 2.3.2.6 Video Output
 - 2.3.2.6.1 Desktop
 - 2.3.2.7 Network Interface
 - 2.3.2.7.1 Desktop
 - 2.3.2.8 Monitor
 - 2.3.2.8.1 Desktop
 - 2.3.2.9 Keyboard and Smart Card Reader
 - 2.3.2.9.1 Desktop

- 2.3.2.10 Mouse
 - 2.3.2.10.1 Desktop
- 2.4 COMPUTER SOFTWARE
 - 2.4.1 Operating System (OS)
 - 2.4.2 Office Automation Software
 - 2.4.3 Virus Protection Software
 - 2.4.4 M&C Controller Hardware Configuration Software
 - 2.4.5 BACnet Network Browser
 - 2.4.6 Monitoring and Control (M&C) Software
 - 2.4.6.1 M&C Software License
 - 2.4.6.1.1 Network Points
 - 2.4.6.1.2 Web Clients
 - 2.4.6.1.3 Calculations
 - 2.4.6.1.4 Other Points
 - 2.4.6.1.5 Alarming
 - 2.4.6.1.6 Trending
 - 2.4.6.2 M&C Software Update Licensing
 - 2.4.6.3 Supported Field Control Protocols
 - 2.4.6.4 Supported Enterprise Protocols
 - 2.4.6.5 Point Information
 - 2.4.6.5.1 Name
 - 2.4.6.5.2 Description
 - 2.4.6.5.3 Value
 - 2.4.6.5.4 Units
 - 2.4.6.5.5 Source
 - 2.4.6.6 Point Calculations
 - 2.4.6.7 Browser-Based Graphical User Interface (GUI)
 - 2.4.6.8 Passwords
 - 2.4.6.9 Graphical System Displays
 - 2.4.6.9.1 Navigation Scheme
 - 2.4.6.9.2 Navigation Commands
 - 2.4.6.10 Graphic Editor
 - 2.4.6.11 System Display Editor
 - 2.4.6.12 Scheduling
 - 2.4.6.13 Alarms
 - 2.4.6.14 Trending
 - 2.4.6.15 Report Generation
 - 2.4.6.16 Custom Report Generation
 - 2.4.6.16.1 Electrical Power Usage Report
 - 2.4.6.16.2 Electrical Peak Demand Prediction Report
 - 2.4.6.16.3 Energy usage Report
 - 2.4.6.16.4 Water Usage Report
 - 2.4.6.16.5 Alarm Report
 - 2.4.6.16.6 M&C Software Override Report
 - 2.4.6.16.7 Run Time Reports
 - 2.4.6.16.8 Device Offline Report
- 2.5 UNINTERRUPTIBLE POWER SUPPLY (UPS)
- 2.6 RACKS AND ENCLOSURES
 - 2.6.1 Enclosures
 - 2.6.1.1 Outdoors
 - 2.6.1.2 Mechanical and Electrical Rooms
 - 2.6.1.3 Other Locations
 - 2.6.2 Equipment Racks

PART 3 EXECUTION

- 3.1 EXISTING CONDITIONS SURVEY
- 3.2 DRAWINGS AND CALCULATIONS
 - 3.2.1 UMCS IP Network Bandwidth Usage Estimate

- 3.2.2 UMCS Contractor Design Drawings
- 3.2.3 As-Built Drawings
- 3.3 INSTALLATION REQUIREMENTS
 - 3.3.1 General
 - 3.3.2 Isolation, Building Penetrations and Equipment Clearance
 - 3.3.3 Nameplates
- 3.4 INSTALLATION OF EQUIPMENT
 - 3.4.1 Wire and Cable Installation
 - 3.4.2 Grounding
 - 3.4.3 Power-Line Surge Protection
 - 3.4.4 IP Addresses
 - 3.4.5 Computer Hardware and Software
 - 3.4.5.1 Hardware Installation
 - 3.4.5.2 Software Installation
 - 3.4.5.3 Monitoring and Control (M&C) Software Configuration
 - 3.4.5.4 Control Hardware Installation
- 3.5 INTEGRATION OF FIELD CONTROL SYSTEMS
 - 3.5.1 Integration Step 1: Install Control Hardware
 - 3.5.1.1 Installation of Control Protocol Gateway
 - 3.5.1.2 Installation of Control Protocol Router
 - 3.5.1.3 Installation of BACnet Supervisory Controller
 - 3.5.2 Integration Step 2: Add Field Control System to M&C Software
 - 3.5.2.1 Integration of Field Control Systems Via ASHRAE 135
 - 3.5.3 Integration Step 3: Configure M&C Software
 - 3.5.3.1 Configure M&C Software Communication
 - 3.5.3.2 Configure M&C Software Functionality
- 3.6 START-UP AND START-UP TESTING
- 3.7 PERFORMANCE VERIFICATION TEST (PVT)
 - 3.7.1 PVT Phase I Procedures
 - 3.7.2 PVT Phase I
 - 3.7.3 PVT Phase II
- 3.8 MAINTENANCE AND SERVICE
 - 3.8.1 Work Coordination
 - 3.8.2 Work Control
 - 3.8.3 Working Hours
 - 3.8.4 Replacement, Modernization, Renovation
 - 3.8.5 Access To UMCS Equipment
 - 3.8.6 Records, Logs, and Progress Reports
 - 3.8.7 Preventive Maintenance Requirements
 - 3.8.7.1 Preventive Maintenance Work Plan
 - 3.8.7.2 Semiannual Maintenance
 - 3.8.7.3 Maintenance Procedures
 - 3.8.7.3.1 Maintenance Coordination
 - 3.8.7.3.2 Software/Firmware
 - 3.8.7.3.3 Network
 - 3.8.8 Service Call Reception
 - 3.8.9 Service Call Work Warranty
 - 3.8.10 System Modifications
- 3.9 TRAINING
 - 3.9.1 Training Documentation
 - 3.9.1.1 Course Attendance List
 - 3.9.1.2 Training Manuals
 - 3.9.2 Basic Training
 - 3.9.3 Advanced Training
 - 3.9.4 Refresher Training

ATTACHMENTS:

QC Checklist

-- End of Section Table of Contents --

SECTION 25 10 10

UTILITY MONITORING AND CONTROL SYSTEM (UMCS) FRONT END AND INTEGRATION
02/19, CHG 1: 05/21

PART 1 GENERAL

1.1 SUMMARY

Provide a Utility Monitoring and Control System (UMCS) which performs supervisory monitoring and supervisory control of base-wide building control systems and utility control systems using ASHRAE 135 (BACnet) protocol as indicated and shown. 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.

The local system in the facility must be connected to and be fully integrated into the existing EMCS front-end/server. The existing EMCS is based on Delta Control system. All DDC and network hardware and components necessary to facilitate communications between local system and the base-wide EMCS must be provided. Network connection to the base-wide network infrastructure by the Government. Coordinate site-specific network hardware and other requirements with the Government.

1.1.1 System Requirements

Provide a UMCS as specified and indicated, and in accordance with the following characteristics:

1.1.1.1 General System Requirements

- a. 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.
- b. 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.
- c. All software used by the UMCS and all software used to install and configure the UMCS is licensed to and delivered to the installation.
- d. 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.
- e. 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.

- f. The UMCS interfaces directly to ASHRAE 135 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.
- g. For UMCS 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.

1.1.1.2 BACnet Requirements

- a. The UMCS must communicate using ASHRAE 135 Annex J over the Government furnished IP network as specified.
- b. All communication between the UMCS 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 Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM, and AF ETL 11-1.

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 RELATED SECTIONS

Cybersecurity requirements related to this Section are specified in a separate cybersecurity specification derived from UFGS Sections 25 05 11.21

CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS FIRE AND LIFE SAFETY SYSTEMS, 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM, and 25 05 11.28 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS - ELECTRONIC SECURITY SYSTEMS. Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS ENERGY MANAGEMENT AND CONTROL SYSTEM specifies cybersecurity requirements related to this Section.

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI INCITS 154	(1988; R 2004) Office Machines and Supplies - Alphanumeric Machines - Keyboard Arrangement
-----------------	--

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

INTERNET ENGINEERING TASK FORCE (IETF)

IETF RFC 7465 (2015) Prohibiting RC4 Cipher Suites
 RFC 821 (2001) Simple Mail Transfer Protocol (SMTP)

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 ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2020) Enclosures for Electrical Equipment
 (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
 National Electrical Code
 NFPA 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-568.1 (2020e) Commercial Building
 Telecommunications Infrastructure Standard
 TIA-606 (2021d) Administration Standard for the
 Telecommunications Infrastructure
 TIA-607 ((2019d) ADDENDUM 1 2021) Generic
 Telecommunications Bonding and Grounding
 (Earthing) for Customer Premises

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 1778 (2014; Reprint Sep 2017) UL Standard for
 Safety Uninterruptible Power Systems
 UL 60950 (2000; Reprint Oct 2007) Safety of
 Information Technology Equipment

1.4 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.

1.4.1 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.

1.4.2 Alarm Handling

see Alarm Routing

1.4.3 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.

1.4.4 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.

1.4.5 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.

1.4.6 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.

1.4.7 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.

1.4.8 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.

1.4.9 BACnet Internetwork (BACnet)

Two or more BACnet networks connected with BACnet routers. In a BACnet Internetwork, there exists only one message path between devices.

1.4.10 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.

1.4.11 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.

1.4.12 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.

1.4.13 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.

1.4.14 BACnet Smart Sensor (B-SS)(BACnet)

A hardware device BTL Listed as a B-SS. A simple sensing device with very 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 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".

1.4.17 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'.

1.4.18 Broadcast

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)

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.

1.4.20 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.

1.4.21 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)

1.4.22 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.

1.4.23 Control Logic Diagram

A graphical representation of control logic for multiple processes that make up a system.

1.4.24 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.

1.4.25 Field Point Of Connection (FPOC)

The FPOC is part of the UMCS IP network and acts as the point of connection between the UMCS 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.)

1.4.26 Field Control Network

The network used by a field control system.

1.4.27 Field Control System (FCS)

A building control system or utility control system.

1.4.28 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.

1.4.29 Internetwork (BACnet)

See BACnet Internetwork.

1.4.30 Modbus

A basic protocol for control network communications generally used in utility control systems. The Modbus protocol standard is maintained by The Modbus Organization.

1.4.31 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.

1.4.32 Monitoring and Control (M&C) Software

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.

1.4.33 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.

1.4.34 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.

1.4.35 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 Utility Monitoring and Control System (UMCS) Monitoring and Control (M&C) Software. Note that this definition is not standard throughout industry.

1.4.36 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.

1.4.37 Point, Network

A value that the M&C Software reads from or writes to a field control network.

1.4.38 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.

1.4.39 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.

1.4.40 Protocol Implementation Conformance Statement (PICS)(BACnet)

A document, created by the manufacturer of a device, which describes which portions of the BACnet standard are implemented by a given device.

1.4.41 Repeater

A device that connects two control network segments and retransmits all information received on one side onto the other.

1.4.42 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.

1.4.43 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.

1.4.44 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).

1.4.45 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.

1.4.46 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.

1.4.47 Supervisory Gateway

A device that is both a supervisory controller and a gateway.

1.4.48 UMCS 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.

1.4.49 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.

1.5 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 and TABLE 1: PROJECT SEQUENCING:

SD-02 Shop Drawings

UMCS Contractor Design Drawings; G

UMCS Contractor Design Drawings as a single complete package: 4 hard copies and 2 copies 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

Draft As-Built Drawings as a single complete package: 4 hard copies and 2 copies 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

Final As-Built Drawings as a single complete package: 4 hard copies and 2 copies 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

Computer Software; G

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; G

SD-05 Design Data

UMCS IP Network Bandwidth Usage Estimate; G, AE

Four copies of the UMCS IP Network Bandwidth Usage Estimate.

SD-06 Test Reports

Pre-Construction QC Checklist; G

Four copies of the Pre-Construction QC Checklist.

Post-Construction QC Checklist; G

Four copies of the Post-Construction QC Checklist.

Existing Conditions Report; G

Four copies of the Existing Conditions Report.

Start-Up and Start-Up Testing Report; G

Four copies of the Start-Up and Start-Up Testing Report. The Start-Up and Testing report may be submitted as a Technical Data Package.

PVT Phase I Procedures; G

Four copies of the PVT Phase I Procedures. The PVT Procedures may be submitted as a Technical Data Package.

PVT Phase I Report; G

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

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

Four bound O&M Instructions and two copies 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

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

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

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

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

Four copies of the Closeout QC Checklist.

1.6 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).

1.6.1 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.

1.6.2 Sequencing for Activities

The sequencing specified for activities indicates the earliest the activity may begin.

1.6.3 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	
2	S	Existing Conditions Report	45 days after #1
3	S	Design Drawings	45 days after #1
4	S	Product Data Sheets	45 days after #1
5	S	UMCS IP Network Bandwidth Usage Estimate	45 days after #1

TABLE I. PROJECT SEQUENCING

ITEM	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY or DEADLINE FOR SUBMITTAL)
6	S	Pre-construction QC Checklist	45 days after #1
7	E	Install UMCS	AAO #2 thru #6
8	E	Start-Up and Start-Up Testing	30 days ACO #7 control system integration into EMCS
9	S	Post-Construction QC Checklist	15 days ACO #8
10	S	Computer Software	15 days ACO #8
11	S	Start-Up and Start-Up Testing Report	30 days ACO #8
12	S	Draft As-Built Drawings	30 days ACO #8
13	S	PVT Phase I Procedures	21 days before scheduled start of #14 and AAO #11
14	E	PVT Phase I	AAO #13 and #12
15	S	PVT Phase I Report	14 days ACO #14
16	S	Preventive Maintenance Work Plan	AAO #11
17	S	O&M Instructions	AAO #11
18	S	Basic Training Documentation	AAO #11 and 14 days before scheduled start of #19
19	E	Basic Training (PVT Phase II)	AAO #16, #17 and #18
20	S	PVT Phase II Report	21 days ACO #19
21	S	Final As-Built Drawings	21 days AAO #20
22	S	Advanced Training Documentation	14 days before schedule start of #23 and AAO #18
23	E	Advanced Training	ACO #19, 21 days AAO #22, and no later than 60 days ACO #19

TABLE I. PROJECT SEQUENCING

ITEM	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY or DEADLINE FOR SUBMITTAL)
24	S	Refresher Training Documentation	14 days before #25 and AAO #18 and #22
25	E	Refresher Training	between 60 and 90 days ACO #19 and AAO #24
26	S	Closeout QC Checklist	ACO #23

1.7 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>

1.8 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Provide UMCS Operation and Maintenance Instructions which include:

- a. Procedures for the UMCS 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

UMCS provide devices which are certified to comply with the requirements of Class B computing devices.

2.1.1.2 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.

2.1.1.3 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 -40 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.

2.1.1.4 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.

2.1.1.5 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 or other ASHRAE 135 network. Devices used as BACnet/IP Routers must be BTL Listed and must support the Network Management-Router Configuration-B (NM-RC-B) BIBB.

2.2.2 Monitoring and Control (M&C) Controller Hardware

Provide Monitoring and Control (M&C) Controller Hardware which is a microprocessor-based direct digital control hardware and which communicates over the UMCS IP network using one of:

- b. ASHRAE 135 in accordance with ASHRAE 135 Annex J and using only Standard ASHRAE 135 services.

2.2.3 BACnet Supervisory Controller Hardware

Provide BACnet Supervisory Controller Hardware which is direct digital control hardware and which:

- a. is BTL Listed
- b. communicates using ASHRAE 135 over an IP network in accordance with ASHRAE 135 Annex J
- c. has a configurable Object_Name Property
- d. supports the following BIBBS
 - (1) DS-RP-B (Data Sharing-Read Property-B) BIBB for Objects requiring read access from the M&C Software
 - (2) DS-WP-B (Data Sharing-Write Property-B) BIBB for Objects requiring write access from the M&C Software.
 - (3) SCHED-E-B (Scheduling-External-B)
 - (4) AE-N-I-B (Alarm and Event-Notification Internal-B)
 - (5) AE-ACK-B (Alarm and Event-ACK-B)
 - (6) T-VMT-I-B (Trending-Viewing and Modifying Trends-Internal-B)
 - (7) T-ATR-B (Trending-Automated Trend Retrieval-B)
- e. has a Writable Recipient_List Property of the Notification Class Object

2.2.4 Control Protocol Gateways

Provide Control Protocol Gateways which perform bi-directional protocol translation between two of the following protocols, or between one of the following protocols and another protocol: ASHRAE 135. Provide Control Protocol Gateways which also meet the following requirements.

- a. Gateways must have two or more separate network connections, each appropriate for the protocol and media used. A single network connection must not be used for both protocols.
- b. Gateways must be capable of being installed, configured and programmed through the use of instructions in the manual supplied by the Contractor.
- c. Provide and license to the Government all software required for gateway configuration.

- d. Gateways must retain their configuration after a power loss of an indefinite time, and must automatically return to their pre-power loss state once power is restored.
- e. Gateways must provide capacity for mapping all required points as indicated plus an additional 20 percent between the two protocols it uses.
- f. Gateways must, in addition, meet all requirements specified (in the following subparagraphs) for each of the two protocols it translates.

2.2.4.1 Gateway for ASHRAE 135

For gateways using ASHRAE 135 provide gateways which meets the following requirements in addition to the requirements for all gateways:

- a. It must allow bi-directional mapping of data in the Gateway to Standard Objects as defined in ASHRAE 135.
- b. All ASHRAE 135 Objects must have a configurable Object_Name Property.
- c. It must be BTL Listed.
- d. Gateways communicating ASHRAE 135 over an IP network must communicate in accordance with ASHRAE 135 Annex J.
- e. Gateways communicating ASHRAE 135 to a field control systems must support the DS-RP-A (Data Sharing-Read Property-A) BIBB and the DS-WP-A (Data Sharing-Write Property-A) BIBB.
- f. Gateways communicating ASHRAE 135 to the M&C Software or to a BACnet Supervisory Controller must support the DS-RP-B (Data Sharing-Read Property-B) BIBB for Objects requiring read access from the M&C Software and the DS-WP-B (Data Sharing-Write Property-B) BIBB for Objects requiring write access from the M&C Software

2.3 COMPUTER HARDWARE

For computer hardware furnished under this specification provide standard products of a single manufacturer which advertises service in all 48 contiguous states, and provide only model currently in production. Except for PCI-E cards installed into expansion slots provided in a desktop or server computer in order to meet the requirements of this specification, do not modify computer hardware from the manufacturer configuration.

2.3.1 Server Hardware

Utilize the existing EMCS Front-End/Server for control and monitoring of new HVAC equipment provided as part of this project.

2.3.2 Workstation Hardware (Desktop and Laptop)

Provide a standard desktop computer or a laptop meeting the following minimum requirements for the Computer Workstation Hardware (workstation) as indicated.

2.3.2.1 Processor

2.3.2.1.1 Desktop

Quad-core processor designed for desktop applications. Processor speed must be at least 75 percent of the speed of the fastest Intel desktop processor commercially available.

2.3.2.2 Random Access Memory (RAM)

300 percent of the recommended requirements of the software to be installed on the server and no less than 8GB.

2.3.2.3 Communications Ports

2.3.2.3.1 Desktop

Six USB ports.

2.3.2.4 Hard Drive and Controller

2.3.2.4.1 Desktop

Hard drives with SATA-3 Controller providing at least 2TB usable disk space. Hard drives must use RAID (Redundant Array of Inexpensive Disks) at levels 1 or 5 (RAID-1 or RAID-5).

2.3.2.4.2 External Hard Drive

4TB disk space with a USB 3.0 interface.

2.3.2.5 Optical Drive

Blu-ray burner drive.

2.3.2.6 Video Output

2.3.2.6.1 Desktop

32-bit color with dual monitor support minimum resolutions of 1920 by 1080 at minimum refresh rates of 70 Hz and dual DVI or display port outputs.

2.3.2.7 Network Interface

2.3.2.7.1 Desktop

Integrated 1000Base-T Ethernet with RJ45 connector.

2.3.2.8 Monitor

2.3.2.8.1 Desktop

Dual widescreen flat panel LCD monitors sized as indicated but no less than 24 inch nominal with minimum resolutions of 1920 by 1080 pixels and a minimum refresh rate of 60Hz.

2.3.2.9 Keyboard and Smart Card Reader

2.3.2.9.1 Desktop

101 key wired USB keyboard having a minimum 64 character standard ASCII character set based on ANSI INCITS 154 and an integral smart card reader compatible with a Department of Defense Common Access Card (CAC).

2.3.2.10 Mouse

2.3.2.10.1 Desktop

2-button wired USB optical scroll mouse with a minimum resolution of 400 dots per inch.

2.4 COMPUTER SOFTWARE

Utilize the existing EMCS Front-End/Server for control and monitoring of new HVAC equipment provided as part of this project. Provide all necessary software and tools as required.

New local DDC system provided under this project must be fully integrated and incorporated into the existing base-wide EMCS. The operation of the new local DDC system provided under this project must operate as a whole and make no distinction between existing and new equipment. The contractor must be responsible to reconfigure and modify the existing EMCS front-end software and programming, including network configuration, mapping over/binding new and existing control points, new graphical displays and database, as necessary.

2.4.1 Operating System (OS)

Provide the latest version of the DISA Gold Master Windows Operating System. The Operating System media will be furnished by the Government. Provide the Operating System license.

2.4.2 Office Automation Software

Provide Office Automation Software consisting of the spreadsheet and word processing portions of the project site's standard office automation software.

2.4.3 Virus Protection Software

Provide Virus Protection Software consisting of the project site's standard virus protection software complete with a virus definition update subscription.

2.4.4 M&C Controller Hardware Configuration Software

Provide M&C Controller Hardware Configuration Software consisting of the software required to configure, program, or configure and program each Monitoring and Control (M&C) Controller Hardware provided for the functions it performs.

2.4.5 BACnet Network Browser

Provide a BACnet Network Browser software that:

- a. Can perform full discovery of a ASHRAE 135 system including but not limited to discovery of all ASHRAE 135 devices, the ASHRAE 135 Objects and Properties of each device, and the standard ASHRAE 135 services supported by each device.
- b. Can read any ASHRAE 135 Property of any Object in any device. Proprietary Properties may be presented as read without further interpretation.
- c. Can write any Standard ASHRAE 135 Property of any Object in any device.
- d. Supports segmentation.
- e. Supports all of the following BIBBs:
 - (1) DM-ANM-A (Device Management-Automatic Network Management-A)
 - (2) DM-ADM-A (Device Management-Automatic Device Management-A)
 - (3) DM-DDB-A (Device Management-Dynamic Device Binding-A)
 - (4) DM-DOB-A (Device Management-Dynamic Object Binding-A)
 - (5) DS-RP-A (Data Sharing-Read Property-A)
 - (6) DS-RPM-A (Data Sharing-Read Property Multiple-A)
 - (7) DS-WP-A (Data Sharing-Write Property-A)

2.4.6 Monitoring and Control (M&C) Software

Provide monitoring and control (M&C) software which is a client-server software package with a graphical user interface (GUI) using web-browser based clients. Provide M&C Software which communicates via ASHRAE 135, and The M&C Software may support other field control protocols. Provide M&C Software which is BACnet Testing Laboratories Certified ("Listed") as a B-AWS.

Provide a single software package which implements 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.

2.4.6.1 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.

2.4.6.1.1 Network Points

A network point is a point brought directly into the Web Supervisor M&C Software through a protocol. Provide M&C Software and licensing to support no less than 100,000 network points, and to be capable of expansion to support no less than 1,000,000 network points.

2.4.6.1.2 Web Clients

Provide M&C Software and licensing to support no less than 50 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 100 simultaneous web clients.

2.4.6.1.3 Calculations

Provide M&C Software and licensing to support no less than one calculated point for every ten network points (see "Network Points" above).

2.4.6.1.4 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.

2.4.6.1.5 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.

2.4.6.1.6 Trending

Provide M&C Software and licensing to support a minimum of 8,000 simultaneous trends.

2.4.6.2 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.

2.4.6.3 Supported Field Control Protocols

Provide M&C Software which supports field control protocols as follows:

- b. The M&C Software must include a driver to ASHRAE 135 over IP in accordance with ASHRAE 135 Annex J.
- f. The M&C Software may, in addition, include drivers to other protocols.

Provide M&C Software capable of reading values from and writing values to points via any supported field protocol, and capable of reading values from one field protocol and writing them to another. All points obtained from any field protocol must be available to all M&C Software

functionality.

2.4.6.4 Supported Enterprise Protocols

Provide M&C Software which supports oBIX, BACnet Web Services or OPC as an enterprise protocol and which meets the following requirements:

- a. It is able to read values from any point or collection of points (network point, internal point, trend log or schedule) and transmit these values via the enterprise protocol.
- b. It is able to receive data via the enterprise protocol and use this data to change the value of any point.
- c. License the enterprise protocol interface to the project site and document the interface such that any system capable of communicating with that protocol can be used to read and write data from the M&C Software.

2.4.6.5 Point Information

Every point, both network and internal, in the M&C Software must contain the following fields:

2.4.6.5.1 Name

A configurable name used for identification of the point within the M&C Software.

2.4.6.5.2 Description

A configurable description of no less than 80 alpha-numeric characters.

2.4.6.5.3 Value

A field containing the current point value.

2.4.6.5.4 Units

A field containing the engineering units.

2.4.6.5.5 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).

2.4.6.6 Point Calculations

Provide M&C software capable of performing calculations and computing the value of a calculated point based on the values of two or more network points and calculated points. Mathematical operators must include: addition, subtraction, multiplication, division, exponentiation (y^x , power), square root, reciprocal, natural logarithm, sin, cos, tan, arcsin, arccos, arctan, and parenthesis. Pi and e must be available as constants for use in calculations.

2.4.6.7 Browser-Based Graphical User Interface (GUI)

Provide M&C Software which includes a web-browser based (client-server) graphical user interface through which all M&C Software functionality, except for the Graphics Editor, System Display Editor, report configuration, point calculation configuration, and enterprise protocol configuration, is accessible.

Provide graphical user interface web server and web clients meeting the following requirements:

- a. The web server must use HTTPS based on the Transport Layer Security (TLS) Protocol in accordance with IETF RFC 7465 using a Government-furnished certificate.
- b. The graphical user interface must be Common Access Card (CAC) enabled: It must support web client authentication using certificates obtained from a Department of Defense Common Access Card (CAC) Smart Card.
- c. The web client must operate on any version of Windows currently supported by Microsoft.
- d. The web client must function in the most recent three version of Internet Explorer and the most recent three versions of Firefox.
- e. The web client must not require a connection to any server other than the M&C Server.
- f. The web client must function in a browser with Java, Shockwave, Silverlight, and Flash installed. The client may require a download of mobile code from the M&C Server, but must not require the download of additional browser plug-ins or add-ins and there must be no limit on the number of downloads. The client must not require ActiveX.

2.4.6.8 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.

2.4.6.9 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.

2.4.6.9.1 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 footprint 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 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.

2.4.6.9.2 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.

2.4.6.10 Graphic Editor

Provide a fully featured graphics editor and capable of creating custom graphics and graphic symbols for use by the System Display Editor.

2.4.6.11 System Display Editor

Provide a system display editor which allows the user to create, modify, and delete graphic displays. The display editor may have a separate user interface and is not required to be accessible via the web browser interface. Provide a display editor which includes the following functions:

- a. Create and save displays. Save an existing or modified display as a new display (i.e. "save as")
- b. Group and ungroup graphics, where graphics include both alphanumeric and graphic symbols, and where a grouped graphic is manipulated as a single graphic.
- c. Place, locate, resize, move, remove, reposition, rotate and mirror a graphic on a display.
- d. Overlay graphics over other graphics and assign depths such that when there are coincident graphics the one on top is visible.
- e. Modify graphic properties based on the value of network points and create conditions governing the display of a graphics such that different graphics are visible based on the value of network points or calculated points
- f. Integrate real-time data with the display.
- g. Establish connecting lines.
- h. Establish sources of latest data and location of readouts.
- i. Display analog values as specified.
- j. Assign conditions which automatically initiate a system display.
- k. Include library of display symbols which include: Pump, Motor, Two- and Three-way Valves, Flow Sensing Element, Point and Averaging Temperature Sensors, Pressure Sensor, Humidity Sensor, Single and Double Deck Air Handling Unit, Fan, Chiller, Boiler, Air Compressor, Chilled Water Piping, Steam Piping, Hot Water Piping, Ductwork, Unit Heater, Pressure Reducing Valve, Damper, Electric Meter, Limit Switch, Flow Switch, High- and Low- Point and Averaging Temperature Switches, High- and Low- Pressure Switches, Coil, Solenoid Valve, Filter, Condensing Unit, Cooling Tower, Variable Frequency Drive (VFD), Heat Exchanger, Current Sensing Relays, Generator, Circuit Breaker, Transformer, Tank. Symbols must at a minimum conform to ASHRAE FUN IP where applicable.

2.4.6.12 Scheduling

- c. The M&C software must be capable of performing time synchronization and configuring Schedule Objects in ASHRAE 135 field devices in accordance with the DM-MTS-A (Device Management-Manual Time Synchronization-A).
- e. The M&C Software must include a scheduling graphic display, accessible via the graphical user interface, with the following fields and functions:

- (1) Current date and time.
- (2) System identifier(s) and name(s), including location information such as Building name(s) and number(s).
- (3) System group. Systems grouped by the user to perform according to a common schedule.
- (4) Weekly schedules. For each system, a weekly schedule based on a seven day per week schedule with independent schedules for each day of the week including no less than 6 value changes per day.
- (5) Holiday and special event schedules. Support for holiday and special event calendar schedules independent of the daily schedule. Special event schedules include one-time events and recurring events. Scheduling of one-time events include the beginning and ending dates and times of the event. Holiday and special event schedules must have precedence over device weekly schedules.

2.4.6.13 Alarms

Provide M&C Software meeting the following minimum requirements for alarms:

- a. The M&C software must be capable of configuring alarms in ASHRAE 135 field devices in accordance with the B-AWS BIBBs
- b. The M&C software must be capable of handling (routing) alarms received as an ASHRAE 135 Alarm Event Notifications.
- d. The M&C software must support at least two alarm priority levels: critical and informational. Critical alarms must remain in alarm until acknowledged by an operator and the alarm condition no longer exists; informational alarms must remain in alarm until the alarm condition no longer exists or until the alarm is acknowledged.
- e. The creation, modification, and handling (routing) of alarms must be fully accessible and fully adjustable from the graphical user interface.
- f. 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.
- g. Alarm Notification and Routing: The M&C software must be capable of performing alarm notification and routing functions. Upon receipt of ASHRAE 135 event notification, the M&C software must immediately perform alarm notification and routing according to an assigned routing for that alarm. The M&C software must support at least 100 alarm routes, where an alarm route is a unique combination of any of the following activities:
- (1) Generate a pop-up up active clients. The pop-up display must include the Alarm Data. Alarms must be capable of being acknowledged from the pop-up display by operators with sufficient permissions. Pop-up must be displayed until acknowledged.
 - (2) Send an e-mail message via simple mail transfer protocol (SMTP; RFC 821). The e-mail must contain a configurable message and all alarm data. The e-mail recipient and scripted message must be user configurable for each alarm route.
 - (3) Print alarms to designated alarm printers. The printed message must be the same as the pop-up message.
- h. Alarm Display and Acknowledgement. The M&C software must include an alarm display. Alarms must be available for display at each workstation as shown, along with all associated alarm data. Alarms must be capable of being acknowledged from this display. Multiple alarms must be capable of being acknowledged using a single command. Operator acknowledgment of one alarm must not automatically be considered as acknowledgment of any other alarm nor may it inhibit reporting of subsequent alarms.
- i. Alarm Storage and Reports: The M&C software must store each alarm and its associated alarm data to hard disk and retain this information after the alarm no longer exists. The stored data must be sortable, searchable, and printable.
- 2.4.6.14 Trending
- Provide M&C software capable of creating, modifying, uploading and archiving ASHRAE 135 Trend Objects in field devices in accordance with the B-AWS BIBBs.
- 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

- b. The M&C software must be capable of displaying and printing a graphical representation of each trend, and of multiple trended points on the same graph. The software must be capable of saving trend logs to a file. If the file format is not plain ASCII text in a Comma-Separated-Value (CSV) format, provide a means to export or convert the file to plain ASCII text in a CSV format.

2.4.6.15 Report Generation

Provide 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. The software must be capable of saving reports to a PDF file and to a file compatible with the provided Office Automation Software.

The software must allow for automatic and manual generation of reports. For automatic reports an operator must be able to specify the time the initial report is to be generated, the time interval between reports, end of period, and the output format for the report. Manual report generation must allow for the operator to request at any time the output of any report.

2.4.6.16 Custom Report Generation

Provide M&C software capable of generating custom reports, including but not limited to the following standard reports:

2.4.6.16.1 Electrical Power Usage Report

An electrical power Usage summary, operator selectable for substations, meters, or transducers, individual meters and transducers, any group of meters and transducers, and all meters for an operator selected time period. The report must include the voltage, current, power factor, electrical demand, electrical power consumption, reactive power (Kvar) for each substation, facility, system or equipment as selected by the operator. The report must be automatically printed at the end of each summary period and include:

- a. Total period consumption.
- b. Demand interval peak for the period, with time of occurrence.
- c. Energy consumption (kWh) over each demand interval.
- d. Time-of-use peak, semi-peak, off-peak, or baseline total kWh consumption.
- e. Reactive power during each demand interval.

- f. Power factor during each demand interval.
- g. Outside air (OA) temperature and relative humidity (RH) taken at the maximum and minimum of OA temperature of the report period with the time and dates of occurrence. At the installation's peak demand interval, the OA temperature and RH must also be recorded.
- h. Calculated heating and cooling degree days based on a 65 degrees F balance point.

2.4.6.16.2 Electrical Peak Demand Prediction Report

A report based on the demand limiting program, which includes:

- a. Electrical Demand Target (EDT).
- b. Actual peak and predicted peak for each demand interval for that day.
- c. Predicted demand for the next demand interval.

2.4.6.16.3 Energy usage Report

An energy usage summary, operator selectable, for a unit, building, area, installation, and the entire UMCS. The report must be divided by utility, and must be capable of reporting on at least four separate utilities. The report must include the following information:

- a. Beginning and ending dates and times.
- b. Total energy usage for each utility for the current and previous day.
- c. Total energy usage for each utility for the current and previous month.
- d. Maximum 15-minute interval average rate of consumption for each utility for the current and previous day and current and previous month.
- e. Outside air (OA) temperature and OA humidity for current and previous month and current and previous day:
 - (1) Average temperature and humidity.
 - (2) Temperature and humidity at maximum and minimum OA temperature with time and date of occurrence.
 - (3) Temperature and humidity at maximum and minimum humidity with time and date of occurrence.
 - (4) Temperature and humidity at the installation's peak demand interval with the time and date of occurrence
- f. Calculated degree days. Reports which include humidity must be configurable to report either dewpoint or relative humidity.

2.4.6.16.4 Water Usage Report

A water usage summary, operator selectable, for a unit, building, area, installation, and the entire UMCS. The report must include the following

information:

- a. Beginning and ending dates and times.
- b. Total energy water usage for the current and previous day.
- c. Total water usage for the current and previous month.

2.4.6.16.5 Alarm Report

Outstanding alarms by building or unit, including time of occurrence.

2.4.6.16.6 M&C Software Override Report

Points overridden by the M&C Software, including time overridden, and identification of operator overriding the point.

2.4.6.16.7 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.

2.4.6.16.8 Device Offline Report

A report listing all offline devices in all ASHRAE 135 building control systems integrated to the M&C Software.

2.5 UNINTERRUPTIBLE POWER SUPPLY (UPS)

Provide uninterruptible power supplies (UPS) as self contained devices suitable for installation and operation at the location of Server and Workstation hardware and sized to provide a minimum of 20 minutes of operation of the connected hardware. Equipment connected to the UPS must not be affected in any manner by a power outage of a duration less than the rated capacity of the UPS. Provide the UPS complete with all necessary power supplies, transformers, batteries, and accessories. Provide UPS which include visual indication of normal power operation, UPS operation, abnormal operation and visual and audible indication of AC input loss and low battery power. Provide UL 1778 approved UPS. UPS powering Server Hardware must notify the server via USB interface of impending battery failure.

2.6 RACKS AND ENCLOSURES

2.6.1 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:

2.6.1.1 Outdoors

For enclosures located outdoors, provide enclosures meeting NEMA 250 Type 3 requirements.

2.6.1.2 Mechanical and Electrical Rooms

For enclosures located in mechanical or electrical rooms, provide enclosures meeting NEMA 250 Type 2 requirements.

2.6.1.3 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.

2.6.2 Equipment Racks

Provide standard 19 inch equipment racks compatible with the electronic equipment provided. Racks must be either aluminum or steel with bolted or welded construction. Steel equipment racks must be painted with a flame-retardant paint. Guard rails must be included with each equipment rack and have a copper grounding bar installed and grounded to the earth.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS SURVEY

Perform a field survey, including but not limited to testing and inspection of equipment to be part of the UMCS, and submit an Existing Conditions Report documenting the current status and its impact on the Contractor's ability to meet this specification. For field control systems to be integrated to the UMCS which are not already connected to the UMCS IP network, verify the availability of the building network backbone at the FPOC location, and verify that FPOCs shown as existing are installed at the FPOC location.

3.2 DRAWINGS AND CALCULATIONS

3.2.1 UMCS IP Network Bandwidth Usage Estimate

Provide a UMCS 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.

3.2.2 UMCS 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 Computer Hardware and Control Hardware.
- c. Physical location for each piece of Computer Hardware and Control

Hardware.

- d. Version and service pack number for all software and for all Control Hardware firmware.

3.2.3 As-Built Drawings

Prepare draft as-built drawings consisting of Points Schedule drawings for the entire UMCS, 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. Network identifier (name) for each printer, computer server and computer workstation.
- d. List of ports, protocols and network services for each device connected to an IP network.
- e. 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.

3.3 INSTALLATION REQUIREMENTS

3.3.1 General

Install system components as shown and specified and in accordance with the manufacturer's instructions and provide necessary interconnections, services, and adjustments required for a complete and operable system. Install communication equipment and cable grounding as necessary to preclude ground loops, noise, and surges from adversely affecting system operation. Install Fiber Optic cables and wiring in exposed areas, including low voltage wiring but not including network cable in telecommunication closets, in metallic raceways or EMT conduit as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Do not install equipment in any space which experiences temperatures or humidity outside of the rated operating range of the equipment.

3.3.2 Isolation, Building Penetrations and Equipment Clearance

Provide dielectric isolation where dissimilar metals are used for connection and support. Make all penetrations through and mounting holes in the building exteriors watertight. Drill or core drill holes in concrete, brick, steel and wood walls with proper equipment. Seal

conduits installed through openings with materials which are compatible with existing materials. Seal openings with materials which meet the requirements of NFPA 70 and SECTION 07 84 00 FIRESTOPPING.

3.3.3 Nameplates

Provide Nameplates for all Control Hardware and all Computer Hardware. Attach Nameplates to the device in a conspicuous location.

3.4 INSTALLATION OF EQUIPMENT

3.4.1 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-568.1 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.

3.4.2 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.

3.4.3 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.

3.4.4 IP Addresses

For all Control Hardware requiring an IP address on the UMCS IP Network, coordinate with the Government to obtain IP addresses.

3.4.5 Computer Hardware and Software

3.4.5.1 Hardware Installation

Install Computer Hardware as specified and indicated. Power Computer Servers through a UPS, and install and configure them such that the server automatically undergoes a clean shutdown upon low battery signal from the UPS.

3.4.5.2 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 or Electrical Peak Demand Limiting, install M&C Software on server 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.

Provide sufficient computer hardware and M&C Controller Hardware and 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.

- c. M&C Controller Hardware Configuration Software: Install the M&C Controller Hardware Configuration Software on server hardware.
- d. Operating system: Install the OS on each Workstation and configure user names and passwords. Coordinate with the Government for user names and passwords.
- e. Office Automation Software: Install the office automation software on each workstation.
- f. Virus Protection software: Install the virus protection software on each workstation and configure weekly virus scans.

Where software requires connection to an IP device outside of the UMCS, coordinate with the Government to obtain access to a Government-furnished server to provide the needed functionality. Do not connect to any device outside of the UMCS without explicit permission from the Government.

3.4.5.3 Monitoring and Control (M&C) Software Configuration

Configure the Monitoring and Control (M&C) Software as specified, as indicated and as follows:

- a. Set up M&C Software user accounts and passwords. Coordinate user accounts, passwords and permissions with the Controls/HVAC shop supervisor.
- b. Change the default password on all accounts. Remove or disable any accounts which do not require authentication (such as guest accounts).
- c. Disable all ports, protocols, and network services other than those required or specifically permitted by this Section. Services to be disabled include but are not limited to: FTP, Telnet and SSH.

3.4.5.4 Control Hardware Installation

Install Control Hardware in a lockable enclosure and as specified. Configure Control Hardware as specified, as required to meet the functions for which the hardware is used and as follows:

- a. Disable all ports, protocols, and network services other than those

required or specifically permitted by this Section. Services to be disabled include but are not limited to: FTP, Telnet, SSH, and HTTP. When disabling of ports, protocols and services is not supported by a product, obtain an exception from this requirement prior to using the product and document non-compliance on the Product Data Sheets and As-Built drawings.

- b. Change the default passwords in all Control Hardware which have passwords. Coordinate new passwords with the Controls/HVAC shop supervisor.

3.5 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 UMCS 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.

3.5.1 Integration Step 1: Install Control Hardware

Install Control Hardware as specified at the FPOC location to connect the field control system to the UMCS 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 Government. 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 Gateway connected to both the field control network and the FPOC.
- c. Install a Control Protocol Router connected to both the field control network and the FPOC.
- d. Install a Control Protocol Gateway connected to the field control network. Then install a Control Protocol Router connected to both the Control Protocol Gateway 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.

3.5.1.1 Installation of Control Protocol Gateway

If the field control system uses a protocol which is not supported by the

M&C Software, install a gateway to convert the field control system protocol to ASHRAE 135. Install additional field control system network media and hardware as needed to connect the Gateway to the field control system. Connect the Gateway according to one of the two following methods:

- a. Connect the Gateway to the field control network and to the FPOC.
- b. Connect the Gateway to the field control network and to a BACnet/IP Router installed as specified.

Create and configure points and establish network communication between the Control Protocol Gateway and the field control system to provide points from the field control system to the M&C software.

3.5.1.2 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.

3.5.1.3 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.

3.5.2 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.

3.5.2.1 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.

3.5.3 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.

3.5.3.1 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.

3.5.3.2 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 using the project site sample displays, including overrides, as shown on the Points Schedule and as specified. Label all points on displays with full English language descriptions and 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 SMTP 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.

3.6 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.

3.7 PERFORMANCE VERIFICATION TEST (PVT)

3.7.1 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.

3.7.2 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.

3.7.3 PVT Phase II

Include Basic Training as part of PVT Phase II. Failures or deficiencies of the UMCS 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.

3.8 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 UMCS 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.

3.8.1 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.

3.8.2 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.

3.8.3 Working Hours

Working hours are from 7:30 A.M. to 4:00 P.M. local time Mondays through Fridays except Federal holidays.

3.8.4 Replacement, Modernization, Renovation

The Government may replace, renovate, or install new equipment as part of the UMCS 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.

3.8.5 Access To UMCS Equipment

Access to UMCS 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 UMCS 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 UMCS 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.

3.8.6 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 UMCS. Keep complete logs and be available for inspection on site, demonstrating that planned and systematic adjustments and repairs have been accomplished for the UMCS.

3.8.7 Preventive Maintenance Requirements

Perform maintenance procedures as described below, or more often if required by the equipment manufacturer. Prepare a Preventive Maintenance Work Plan as specified.

3.8.7.1 Preventive Maintenance Work Plan

Prepare a Preventive Maintenance Work Plan to schedule 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.

3.8.7.2 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 UMCS 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.

3.8.7.3 Maintenance Procedures

3.8.7.3.1 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 non-redundant computer workstation hardware, provide 7 days notice, components must be off-line for no more than 8 hours.
- c. for redundant computer server hardware, provide 7 days notice, components must be off-line for no more than 36 hours.
- d. For redundant computer workstation hardware, provide 4 days notice, components must be off-line for no more than 48 hours.
- e. For active (powered) control hardware, provide 14 days notice, components must be off-line for no more than 6 hours.

- f. For cabling and other passive network hardware, provide 21 days notice, components must be off-line for no more than 12 hours.

3.8.7.3.2 Software/Firmware

Software/firmware maintenance includes operating systems, application programs, and files required for the proper operation of the UMCS regardless of storage medium. User (project site) developed software is not covered by this contract, except that the UMCS 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 UMCS 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.

3.8.7.3.3 Network

Network maintenance includes testing transmission media and equipment to verify signal levels, system data rates, errors and overall system performance.

3.8.8 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. 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 12 hours after regular working hours or as needed to meet the Equipment Repair requirements as specified.

3.8.9 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.

3.8.10 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.

3.9 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.

3.9.1 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:

3.9.1.1 Course Attendance List

Course Attendance List developed in coordination with and signed by the Controls/HVAC shop supervisor.

3.9.1.2 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.

3.9.2 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.

3.9.3 Advanced Training

Conduct an Advanced Operator Training course at the project site for a period of not less than 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 UMCS. 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.

3.9.4 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 UMCS. Correct any system failures discovered during the Refresher Training at no cost to the Government.

APPENDIX A

<u>QC CHECKLIST</u>		
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:)		
<input type="checkbox"/>	Pre-Construction QC Checklist Submittal (Items 1-2)	()
<input type="checkbox"/>	Post-Construction QC Checklist Submittal (Items 1-6)	()
<input type="checkbox"/>	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.	____

<u>QC CHECKLIST</u>		
4	Connections to non-ASHRAE 135 field control systems are via a Gateway from the field control system to ASHRAE 135 or via a UMCS supported protocol without the use of a hardware Gateway.	____
5	Computer workstations and servers are installed as shown on the UMCS 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.	____

<u>QC CHECKLIST</u>		
14	Basic Operator and Advanced Training courses have been completed.	____
(QC Representative Signature) (Date)		

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING

08/08, CHG 2: 08/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Acceptance Tests and Inspections Reports
 - 1.4.2 Acceptance Test and Inspections Procedure

PART 2 PRODUCTS

PART 3 EXECUTION

- 3.1 ACCEPTANCE TESTS AND INSPECTIONS
- 3.2 SYSTEM ACCEPTANCE
- 3.3 PLACING EQUIPMENT IN SERVICE

-- End of Section Table of Contents --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING
08/08, CHG 2: 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.

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 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-06 Test Reports

Acceptance Tests and Inspections; G

SD-07 Certificates

Acceptance Test and Inspections Procedure; G

1.4 QUALITY ASSURANCE

1.4.1 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.

1.4.2 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 24 13 SWITCHBOARDS

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 12 19.10

THREE-PHASE, LIQUID-FILLED PAD-MOUNTED TRANSFORMERS

05/19, CHG 1: 11/19

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS
 - 1.4.1 Reduced Submittal Requirements
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Pad-Mounted Transformer Drawings
 - 1.5.2 Regulatory Requirements
 - 1.5.3 Standard Products
 - 1.5.3.1 Alternative Qualifications
 - 1.5.3.2 Material and Equipment Manufacturing Date
- 1.6 MAINTENANCE
 - 1.6.1 Additions to Operation and Maintenance Data

PART 2 PRODUCTS

- 2.1 PRODUCT COORDINATION
- 2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS
 - 2.2.1 Compartments
 - 2.2.1.1 High Voltage, Dead-Front
 - 2.2.1.2 Low Voltage
 - 2.2.2 Transformer
 - 2.2.2.1 Specified Transformer Efficiencies
 - 2.2.3 Insulating Liquid
 - 2.2.3.1 Liquid-Filled Transformer Nameplates
 - 2.2.4 Corrosion Protection
- 2.3 WARNING SIGNS AND LABELS
- 2.4 ARC FLASH WARNING LABEL
- 2.5 GROUNDING AND BONDING
- 2.6 CAST-IN-PLACE CONCRETE
- 2.7 SOURCE QUALITY CONTROL
 - 2.7.1 Transformer Test Schedule
 - 2.7.2 Design Tests
 - 2.7.3 Routine and Other Tests

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 GROUNDING
 - 3.2.1 Grounding Electrodes
 - 3.2.2 Pad-Mounted Transformer Grounding
 - 3.2.3 Connections
 - 3.2.4 Grounding and Bonding Equipment
- 3.3 INSTALLATION OF EQUIPMENT AND ASSEMBLIES

- 3.4 FIELD APPLIED PAINTING
- 3.5 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES
 - 3.5.1 Cast-In-Place Concrete
 - 3.5.2 Sealing
- 3.6 FIELD QUALITY CONTROL
 - 3.6.1 Performance of Acceptance Checks and Tests
 - 3.6.1.1 Pad-Mounted Transformers
 - 3.6.1.2 Grounding System
 - 3.6.1.3 Surge Arresters, Medium- and High-Voltage
 - 3.6.2 Follow-Up Verification

-- End of Section Table of Contents --

SECTION 26 12 19.10

THREE-PHASE, LIQUID-FILLED PAD-MOUNTED TRANSFORMERS
05/19, CHG 1: 11/19

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM A240/A240M	(2020a) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM 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 C57.12.29	(2014) Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE C57.12.34	(2015) Standard Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers, 10 MVA and Smaller; High Voltage, 34.5 kV Nominal System Voltage and Below; Low Voltage, 15 kV Nominal System Voltage and Below
IEEE C57.12.80	(2010) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(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; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
---------	---

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (OECD)

OECD Test 203	(1992) Fish Acute Toxicity Test
---------------	---------------------------------

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 712-C-98-075	(1998) Fate, Transport and Transformation Test Guidelines - OPPTS 835.3100- "Aerobic Aquatic Biodegradation"
------------------	--

EPA 821-R-02-012 (2002) Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 431 Energy Efficiency Program for Certain Commercial and Industrial Equipment

UNDERWRITERS LABORATORIES (UL)

UL 467 (2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Pad-mounted Transformer Drawings; G

SD-03 Product Data

Pad-mounted Transformers; G

SD-06 Test Reports

Acceptance Checks and Tests; G

SD-07 Certificates

Transformer Efficiencies; G

SD-09 Manufacturer's Field Reports

Transformer Test Schedule; G

Pad-mounted Transformer Design Tests; G

Pad-mounted Transformer Routine and Other Tests; G

SD-10 Operation and Maintenance Data

Transformer(s), Data Package 5; G

1.4.1 Reduced Submittal Requirements

Transformers designed and manufactured by ABB in Jefferson City, MO; by Eaton's Cooper Power Series Transformers in Waukesha, WI; by ERMCO in Dyersburg, TN; or by Howard Industries in Laurel, MS need not submit the entire submittal package requirements of this contract. Instead, submit the following items:

- a. A certification, signed by the manufacturer, stating that the manufacturer will meet the technical requirements of this specification.
- b. An outline drawing of the transformer with devices identified (paragraph PAD-MOUNTED TRANSFORMER DRAWINGS, item a).
- c. ANSI nameplate data of the transformer (paragraph PAD-MOUNTED TRANSFORMER DRAWINGS, item b).
- d. Provide transformer test schedule and routine and other tests required by submittal item "SD-09 Manufacturer's Field Reports".
- e. Provide acceptance test reports required by submittal item "SD-06 Test Reports".
- f. Provide operation and maintenance manuals required by submittal item "SD-10 Operation and Maintenance Data".

1.5 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).

1.5.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, except of NFPA 70 when more stringent requirements are specified or indicated, as though the word "must" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Provide equipment, materials, installation, and workmanship in accordance with NFPA 70 unless more stringent requirements are specified or indicated.

1.5.3 Standard Products

Provide materials and equipment that are products of manufacturers

regularly engaged in the production of such products which are of equal material, design and workmanship, and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.
- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.3.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.6 MAINTENANCE

1.6.1 Additions to Operation and Maintenance Data

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein. In addition to requirements of Data Package 5, include the following on the actual transformer(s) provided:

- a. An instruction manual with pertinent items and information highlighted
- b. An outline drawing, front, top, and side views
- c. Prices for spare parts and supply list
- d. Routine and field acceptance test reports
- e. Fuse curves for primary fuses
- f. Actual nameplate diagram
- g. Date of purchase

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be pad-mounted transformers and related accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.2 THREE-PHASE PAD-MOUNTED TRANSFORMERS

IEEE C57.12.34, IEEE C57.12.28 and as specified herein. Submit manufacturer's information for each component, device, insulating fluid, and accessory provided with the transformer.

2.2.1 Compartments

Provide high- and low-voltage compartments separated by steel isolating barriers extending the full height and depth of the compartments. Compartment doors: hinged lift-off type with stop in open position and three-point latching.

2.2.1.1 High Voltage, Dead-Front

High-voltage compartment contains: the incoming line, insulated high-voltage 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, protective caps, and ground pad.

Minimum high-voltage compartment dimensions: IEEE C57.12.34, Figures 16 and 17.

- a. Insulated high-voltage dead-break connectors: IEEE 386, rated 15 kV, 95 kV BIL. Current rating: 600 amperes rms continuous. Short time rating: 25,000 amperes rms symmetrical for a time duration of 0.17 seconds. Connector must have a 200 ampere bushing interface for surge arresters, steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material.

- b. Bushing well inserts and feed-thru inserts: IEEE 386, 200 amperes, 15 kV Class. Provide a bushing well insert for each bushing well unless indicated otherwise.

- c. Load-break switch

Radial-feed two-position oil-immersed type 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 handle in the high-voltage compartment.

- 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 15 kV, fully shielded, dead-front, metal-oxide-varistor, elbow type with resistance-graded gap. Provide three arresters for radial feed circuits.
- f. Parking stands: Provide a parking stand near each bushing. Provide insulated standoff bushings for parking of energized high-voltage connectors on parking stands.
- g. Protective caps: IEEE 386, 600 amperes, 15 kV Class. Provide insulated protective caps (not shipping caps) for insulating and sealing out moisture from unused bushings.

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.

2.2.2 Transformer

- a. Less-flammable bio-based liquid-insulated or oil-insulated, two winding, 60 hertz, 65 degrees C rise above a 30 degrees C average ambient, self-cooled type.
- b. Transformer rated as indicated.
- c. Transformer voltage ratings: as indicated.
- d. Tap changer: externally operated, manual type for changing tap setting when the transformer is de-energized. Provide four 2.5 percent full capacity taps, two above and two below rated primary voltage. Indicate which tap setting is in use, clearly visible when the compartment is opened.
- e. Minimum tested percent impedance at 85 degrees C:
 - 2.50 for units rated 75kVA and below
 - 2.87 for units rated 112.5kVA to 300kVA
 - 4.03 for 500kVA rated units
 - 5.32 for units rated 750kVA and above
- f. Comply with the following audible sound level limits:

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.

<u>kVA</u>	<u>EFFICIENCY</u> <u>(percent)</u>
15	98.65
30	98.83
45	98.92
75	99.03

112.5	99.11
150	99.16
225	99.23
300	99.27
500	99.35
750	99.40
1000	99.43
1500	99.48
2000	99.51
2500	99.53
above 2500	99.54

2.2.3 Insulating Liquid

- a. Less-flammable transformer liquids: NFPA 70 and FM APP GUIDE for less-flammable liquids having a fire point not less than 300 degrees C tested per ASTM D92 and a dielectric strength not less than 33 kV tested per ASTM D877/D877M. Provide identification of transformer as "non-PCB" and "manufacturer's name and type of fluid" on the nameplate.

Provide a fluid that is a biodegradable, electrical insulating, and cooling liquid classified by UL and approved by FM as "less flammable" with the following properties:

- (1) Pour point: ASTM D97, less than -15 degree C
- (2) Aquatic biodegradation: EPA 712-C-98-075, ultimately biodegradable as designated by EPA.
- (3) Trout toxicity: OECD Test 203, zero mortality of EPA 821-R-02-012, pass

2.2.3.1 Liquid-Filled Transformer Nameplates

Provide nameplate information in accordance with IEEE C57.12.00 and as modified or supplemented by this section.

2.2.4 Corrosion Protection

Provide corrosion resistant bases and cabinets of transformers, fabricated of stainless steel conforming to ASTM A240/A240M, Type 304 or 304L. Base includes any part of pad-mounted transformer that is within 3 inches of concrete pad.

Paint entire transformer assembly Munsell 7GY3.29/1.5 green, with paint coating system complying with IEEE C57.12.28 and IEEE C57.12.29 regardless of base, cabinet, and tank material. The Munsell color notation is

specified in ASTM D1535.

2.3 WARNING SIGNS AND LABELS

Provide warning signs for the enclosures of pad-mounted transformers having a nominal rating exceeding 600 volts in accordance with NEMA Z535.4 and NEMA 260.

- a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28, such as for pad-mounted transformers, provide self-adhesive warning labels on the outside of the high voltage compartment door(s) with nominal dimensions of 7 by 10 inches with the legend "WARNING HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. Include the word "WARNING" in white letters on an orange background and the words "HIGH VOLTAGE" in black letters on a white background.

2.4 ARC FLASH WARNING LABEL

Provide arc flash warning label for the enclosure of pad-mounted transformers. Locate this self-adhesive warning label on the outside of the high voltage compartment door warning of potential electrical arc flash hazards and appropriate PPE required. Provide label format as indicated.

2.5 GROUNDING AND BONDING

UL 467. Provide grounding and bonding as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.6 CAST-IN-PLACE CONCRETE

Provide concrete associated with electrical work for other than encasement of underground ducts rated for 4000 psi minimum 28-day compressive strength unless specified otherwise. Conform to the requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE.

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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM

08/19, CHG 2: 05/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Fuses
 - 1.4.2 Regulatory Requirements
 - 1.4.3 Standard Products
 - 1.4.3.1 Alternative Qualifications
 - 1.4.3.2 Material and Equipment Manufacturing Date
- 1.5 MAINTENANCE
 - 1.5.1 Electrical Systems
- 1.6 WARRANTY

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
- 2.2 CONDUIT AND FITTINGS
 - 2.2.1 Rigid Metallic Conduit
 - 2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit
 - 2.2.1.2 Rigid Aluminum Conduit
 - 2.2.2 Rigid Nonmetallic Conduit
 - 2.2.3 Intermediate Metal Conduit (IMC)
 - 2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)
 - 2.2.5 Plastic-Coated Rigid Steel and IMC Conduit
 - 2.2.6 Flexible Metal Conduit
 - 2.2.6.1 Liquid-Tight Flexible Metal Conduit, Steel
 - 2.2.7 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit
 - 2.2.7.1 Fittings for Rigid Metal Conduit and IMC
 - 2.2.7.2 Fittings for EMT
 - 2.2.8 Fittings for Rigid Nonmetallic Conduit
- 2.3 CABLE TRAYS
 - 2.3.1 Basket-Type Cable Trays
 - 2.3.2 Ladder-Type Cable Trays
- 2.4 OPEN TELECOMMUNICATIONS CABLE SUPPORT
 - 2.4.1 Open Top Cable Supports
 - 2.4.2 Closed Ring Cable Supports
- 2.5 OUTLET BOXES AND COVERS
 - 2.5.1 Floor Outlet Boxes
 - 2.5.2 Outlet Boxes for Telecommunications System
 - 2.5.3 Clock Outlet for Use in Other Than Wired Clock System
- 2.6 CABINETS, JUNCTION BOXES, AND PULL BOXES
- 2.7 WIRES AND CABLES
 - 2.7.1 Conductors
 - 2.7.1.1 Minimum Conductor Sizes

- 2.7.2 Color Coding
 - 2.7.2.1 Ground and Neutral Conductors
 - 2.7.2.2 Ungrounded Conductors
- 2.7.3 Insulation
- 2.7.4 Bonding Conductors
 - 2.7.4.1 Telecommunications Bonding Backbone (TBB)
 - 2.7.4.2 Bonding Conductor for Telecommunications
- 2.7.5 Service Entrance Cables
- 2.8 SPLICES AND TERMINATION COMPONENTS
- 2.9 DEVICE PLATES
- 2.10 SWITCHES
 - 2.10.1 Toggle Switches
 - 2.10.2 Switch with Red Pilot Handle
 - 2.10.3 Disconnect Switches
- 2.11 FUSES
 - 2.11.1 Fuseholders
 - 2.11.2 Cartridge Fuses, Current Limiting Type (Class T)
- 2.12 RECEPTACLES
 - 2.12.1 Split Duplex Receptacles
 - 2.12.2 Weatherproof Receptacles
 - 2.12.3 Ground-Fault Circuit Interrupter Receptacles
- 2.13 PANELBOARDS
 - 2.13.1 Enclosure
 - 2.13.2 Panelboard Buses
 - 2.13.3 Circuit Breakers
 - 2.13.3.1 Multipole Breakers
 - 2.13.3.2 Circuit Breaker With Ground-Fault Circuit Interrupter
- 2.14 ENCLOSED CIRCUIT BREAKERS
- 2.15 TRANSFORMERS
 - 2.15.1 Specified Transformer Efficiency
- 2.16 MOTORS
 - 2.16.1 High Efficiency Single-Phase Motors
 - 2.16.2 Premium Efficiency Polyphase and Single-Phase Motors
 - 2.16.3 Motor Sizes
 - 2.16.4 Wiring and Conduit
- 2.17 MOTOR CONTROLLERS
 - 2.17.1 Control Wiring
 - 2.17.2 Control Circuit Terminal Blocks
 - 2.17.2.1 Types of Terminal Blocks
 - 2.17.3 Control Circuits
 - 2.17.4 Enclosures for Motor Controllers
 - 2.17.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers
 - 2.17.6 Pushbutton Stations
 - 2.17.7 Pilot and Indicating Lights
- 2.18 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)
- 2.19 LOCKOUT REQUIREMENTS
- 2.20 TELECOMMUNICATIONS SYSTEM
- 2.21 COMMUNITY ANTENNA TELEVISION (CATV) SYSTEM
 - 2.21.1 CATV Faceplates
- 2.22 GROUNDING AND BONDING EQUIPMENT
 - 2.22.1 Ground Rods
 - 2.22.2 Ground Bus
 - 2.22.3 Secondary Bonding Busbar
- 2.23 MANUFACTURER'S NAMEPLATE
- 2.24 FIELD FABRICATED NAMEPLATES
- 2.25 WARNING SIGNS
- 2.26 FIRESTOPPING MATERIALS
- 2.27 WIREWAYS

- 2.28 SURGE PROTECTIVE DEVICES
- 2.29 FACTORY APPLIED FINISH
- 2.30 SOURCE QUALITY CONTROL
 - 2.30.1 Transformer Factory Tests
- 2.31 COORDINATED POWER SYSTEM PROTECTION

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Underground Service
 - 3.1.2 Service Entrance Identification
 - 3.1.2.1 Labels
 - 3.1.3 Wiring Methods
 - 3.1.3.1 Pull Wire
 - 3.1.4 Conduit Installation
 - 3.1.4.1 Restrictions Applicable to Aluminum Conduit
 - 3.1.4.2 Restrictions Applicable to EMT
 - 3.1.4.3 Restrictions Applicable to Nonmetallic Conduit
 - 3.1.4.4 Restrictions Applicable to Flexible Conduit
 - 3.1.4.5 Underground Conduit
 - 3.1.4.6 Conduit Installed Under Floor Slabs
 - 3.1.4.7 Conduit Through Floor Slabs
 - 3.1.4.8 Conduit Installed in Concrete Floor Slabs
 - 3.1.4.9 Stub-Ups
 - 3.1.4.10 Conduit Support
 - 3.1.4.11 Directional Changes in Conduit Runs
 - 3.1.4.12 Locknuts and Bushings
 - 3.1.4.13 Flexible Connections
 - 3.1.4.14 Telecommunications and Signal System Pathway
 - 3.1.4.15 Community Antenna Television (CATV) System Conduits
 - 3.1.5 Cable Tray Installation
 - 3.1.6 Telecommunications Cable Support Installation
 - 3.1.7 Boxes, Outlets, and Supports
 - 3.1.7.1 Boxes
 - 3.1.7.2 Pull Boxes
 - 3.1.7.3 Extension Rings
 - 3.1.8 Mounting Heights
 - 3.1.9 Conductor Identification
 - 3.1.9.1 Marking Strips
 - 3.1.10 Splices
 - 3.1.11 Covers and Device Plates
 - 3.1.12 Electrical Penetrations
 - 3.1.13 Grounding and Bonding
 - 3.1.13.1 Ground Rods
 - 3.1.13.2 Grounding Connections
 - 3.1.13.3 Ground Bus
 - 3.1.13.4 Resistance
 - 3.1.13.5 Telecommunications System
 - 3.1.14 Equipment Connections
 - 3.1.15 Elevator
 - 3.1.16 Surge Protective Devices
- 3.2 FIELD FABRICATED NAMEPLATE MOUNTING
- 3.3 WARNING SIGN MOUNTING
- 3.4 FIELD APPLIED PAINTING
- 3.5 FIELD QUALITY CONTROL
 - 3.5.1 Devices Subject to Manual Operation
 - 3.5.2 600-Volt Wiring Test
 - 3.5.3 Transformer Tests
 - 3.5.4 Ground-Fault Receptacle Test

- 3.5.5 Arc-Fault Receptacle Test
- 3.5.6 Grounding System Test
- 3.5.7 Watthour Meter
- 3.5.8 Phase Rotation Test

-- End of Section Table of Contents --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM

08/19, CHG 2: 05/21

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM 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

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	(2018) Motors and Generators
NEMA MG 10	(2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(2014) Dry-Type Transformers for General Applications
NEMA TC 2	(2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2016) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA VE 1	(2017) Metal Cable Tray Systems
NEMA WD 1	(1999; R 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; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
---------	--

National Electrical Code

NFPA 70E (2021) Standard for Electrical Safety in the Workplace

NFPA 780 (2020) Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-568-C.1 (2009; Add 2 2011; Add 1 2012) Commercial Building Telecommunications Cabling Standard

TIA-569 (2019e) ADDENDUM 1 2019) Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-607 ((2019d) ADDENDUM 1 2021) 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 248-15	(2018) Low-Voltage Fuses - Part 15: Class T Fuses
UL 360	(2013; Reprint Oct 2020) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2018; Reprint May 2021) UL Standard for Safety Wire Connectors
UL 486C	(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 Feb 2021) UL Standard for Safety Attachment Plugs and Receptacles
UL 506	(2017) UL Standard for Safety Specialty Transformers
UL 508	(2018) UL Standard for Safety Industrial Control Equipment
UL 510	(2020) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(2013; Reprint Aug 2017) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint May 2020) Conduit, Tubing and Cable Fittings
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(2011; Reprint Mar 2020) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL 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 870	(2016; Reprint Mar 2019) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings

UL 943	(2016; Reprint Feb 2018) UL Standard for Safety Ground-Fault Circuit-Interrupters
UL 984	(1996; Reprint Sep 2005) Hermetic Refrigerant Motor-Compressors
UL 1063	(2017) UL Standard for Safety Machine-Tool Wires and Cables
UL 1242	(2006; Reprint Aug 2020) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1449	(2021) UL Standard for Safety Surge Protective Devices
UL 1699	(2017; Reprint Nov 2020) UL Standard for Safety Arc-Fault Circuit-Interrupters
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	(2017) UL Standard for Safety Fuseholders - Part 1: General Requirements

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 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

Panelboards; G

Transformers; G

Cable Trays; G

Wireways; G

Marking Strips Drawings; G

SD-03 Product Data

Receptacles; G

Circuit Breakers; G

Switches; G

Transformers; G

Enclosed Circuit Breakers; G

Motor Controllers; G

Manual Motor Starters; G

CATV Outlets; G

Secondary Bonding Busbar; G

Surge Protective Devices; G

SD-06 Test Reports

600-volt Wiring Test; G

Grounding System Test; G

Transformer Tests; G

Ground-fault Receptacle Test; G

Arc-fault Receptacle Test; G

SD-07 Certificates

Fuses; G

SD-09 Manufacturer's Field Reports

Transformer Factory Tests

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5; G

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "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 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein. Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. Include the following:

- a. Single line diagram of the "as-built" building electrical system.
- b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).
- c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

Provide equipment items supported by service organizations that are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

2.2 CONDUIT AND FITTINGS

Conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40 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:

- a. Cable trays: form a wireway system, with a nominal 4 inch depth as indicated.
- 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 18-inch wide by 4-inch deep with maximum wire mesh spacing of 2 by 4 inch.

2.3.2 Ladder-Type Cable Trays

Provide 24-inch wide with a 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 galvanized steel open top cable supports.

2.4.2 Closed Ring Cable Supports

Provide closed ring cable supports in accordance with UL 2043. Provide zinc-coated closed ring cable supports.

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: nonadjustable and concrete tight.
- b. Each outlet: consisting of cast-metal body with threaded openings, or sheet-steel body with knockouts for conduits, ring, and cover plate

with 1 inch threaded plug.

- c. Telecommunications outlets: consisting of surface-mounted, , stainless steel housing with a receptacle as specified and one inch bushed 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 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.

2.5.3 Clock Outlet for Use in Other Than Wired Clock System

Provide the following:

- a. Outlet box with plastic cover, where required, and single receptacle with clock outlet plate.
- b. Receptacle: recessed sufficiently within box to allow complete insertion of standard cap, flush with plate.
- c. Suitable clip or support for hanging clock: secured to top plate.
- d. Material and finish of plate: as specified in paragraph DEVICE PLATES of this section.

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 4X 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 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

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 or of the solderless pressure type having suitable conductor-release arrangement.
- 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 1 or 3R, enclosure as indicated per NEMA ICS 6.

2.11 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch panel and control center. 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 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-wire power contacts and double or triple-wire 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, polycarbonate, UV resistant/stabilized 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.

2.13 PANELBOARDS

Provide panelboards in accordance with the following:

- a. UL 67 and UL 50.
- b. Panelboards for use as service disconnecting: 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. Where "space only" is indicated, make provisions for future installation of breaker sized as indicated.
- f. Directories: indicate load served by each circuit of panelboard.
- g. Directories: indicate source of service (e.g. upstream panel, switchboard, motor control center) to panelboard.
- h. Type directories and mount in holder behind transparent protective covering.
- i. 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. Outdoor cabinets: NEMA 3R raintight with conduit hubs welded to the cabinet.
- e. Front edges of cabinets: form-flanged or fitted with structural shapes welded or riveted to the sheet steel, for supporting the panelboard front.
- f. All cabinets: fabricated such that no part of any surface on the finished cabinet deviates from a true plane by more than 1/8 inch.

- g. Holes: provided in the back of indoor surface-mounted cabinets, with outside spacers and inside stiffeners, for mounting the cabinets with a 1/2 inch clear space between the back of the cabinet and the wall surface.
- h. Flush doors: mounted on hinges that expose only the hinge roll to view when the door is closed.
- i. Each door: fitted with a combined catch and lock latch.
- j. Keys: two provided with each lock, with all locks keyed alike.
- k. Finished-head cap screws: provided for mounting the panelboard fronts on the cabinets.

2.13.2 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 four 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.

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).

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.

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.

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 pole designed for flush mounting with overload protection.

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 structures (pathway), 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.

2.21 COMMUNITY ANTENNA TELEVISION (CATV) SYSTEM

2.21.1 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.

2.22 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. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.
- f. Minimum size of nameplates: one by 2.5 inches.
- g. Lettering size and style: a minimum of 0.25 inch high normal block style.

2.25 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 WIREWAYS

UL 870. Material: steel epoxy painted 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with hinged- cover NEMA 1 enclosure per NEMA ICS 6.

2.28 SURGE PROTECTIVE DEVICES

Provide parallel type surge protective devices (SPD) which comply with UL 1449 at the service entrance, panelboards and as indicated. 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

The minimum MCOV (Maximum Continuous Operating Voltage) rating for L-N and L-G modes of operation: 120 percent of nominal voltage for 240 volts and below; 115 percent of nominal voltage above 240 volts to 480 volts.

2.29 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,.
- g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.30 SOURCE QUALITY CONTROL

2.30.1 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.

2.31 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 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. 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.

-

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 Installed Under Floor Slabs

Conduit run under floor slab: located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier. Use NECA NEIS 1 Table 2a (Minimum Raceway Spacing) to determine under

floor slab conduit spacing unless greater spacing is required elsewhere in this section.

3.1.4.7 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.

3.1.4.8 Conduit Installed in Concrete Floor Slabs

PVC, Type EPC-40, unless indicated otherwise. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends must not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings must allow horizontal and vertical movement of raceway. Conduit larger than one inch trade size: installed parallel with or at right angles to main reinforcement; when at right angles to reinforcement, install conduit close to one of supports of slab.

3.1.4.9 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.

3.1.4.10 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.

3.1.4.11 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.

3.1.4.12 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.

3.1.4.13 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures. 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 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.

3.1.4.14 Telecommunications and Signal System Pathway

Install telecommunications pathway in accordance with TIA-569.

- a. Horizontal Pathway: Telecommunications pathways from the work area to the telecommunications room: installed and cabling length requirements in accordance with TIA-568-C.1. Size conduits, wireways, and cable trays in accordance with TIA-569.
- 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.

3.1.4.15 Community Antenna Television (CATV) System Conduits

Install a system of CATV wire-supporting structures (pathway), including: outlet boxes, conduits with pull wires wireways, cable trays, and other accessories for CATV outlets and pathway in accordance with TIA-569. Provide distribution system with star topology with empty conduit and pullwire from each outlet box to the telecommunications room and empty conduit and pullwire from each telecommunications room to the headend equipment location.

3.1.5 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. Support in accordance with manufacturer recommendations but at not more than 6 foot intervals. 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. Support at maximum 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 through smoke and fire partitions in 4 inch rigid steel conduits with grounding bushing, extending 12 inches beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.6 Telecommunications Cable Support Installation

Install open top and closed ring cable supports on 4 ft to 5 ft centers to adequately support and distribute the cable's weight. Use these types of supports to support a maximum of 50 0.25 in diameter cables. Install suspended cables with at least 3 in of clear vertical space above the ceiling tiles and support channels (T-bars). Open top and closed ring cable supports: suspended from or attached to the structural ceiling or walls with hardware or other installation aids specifically designed to support their weight.

3.1.7 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways: cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, 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. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.7.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Telecommunications outlets: a minimum of 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.

3.1.7.2 Pull Boxes

Construct of at least minimum size required by NFPA 70 of code-gauge aluminum or galvanized sheet steel, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.7.3 Extension Rings

Extension rings are not permitted for new construction.

3.1.8 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 and handicapped telecommunications stations 48 inches above finished floor. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Mount other devices as indicated. Measure mounting heights of wiring devices and outlets to center of device or outlet.

3.1.9 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC. Provide telecommunications system conductor identification as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.

3.1.9.1 Marking Strips

Provide marking strips for identification of power distribution, control, data, and communications cables in accordance with the following:

- a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.
- b. Use permanent ink for the wire numbers
- c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.
- d. Size marking strips to accommodate the two sets of wire numbers.
- e. Assign a device designation in accordance with NEMA ICS 1 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams.
- f. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.
- g. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.10 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.11 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates

installed in wet locations.

3.1.12 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.13 Grounding and Bonding

Provide in accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems.

Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with NFPA 70.

Make ground connection to driven ground rods on exterior of building. Bond additional driven rods together with a minimum of 4 AWG soft bare copper wire buried to a depth of at least 12 inches. Interconnect all grounding media in or on the structure to provide a common ground potential. This includes lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Make interconnection to the gas line on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.13.1 Ground Rods

Provide ground rods and measure the resistance to ground using the fall-of-potential method described in IEEE 81. Do not exceed 25 ohms under normally dry conditions for the maximum resistance of a driven ground. If this resistance cannot be obtained with a single rod, additional rods, spaced on center. Spacing for additional rods must be a minimum of 10 feet. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.13.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, by exothermic weld or high compression connector.

- a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.
- b. Make high compression connections using a hydraulic or electric compression tool to provide the correct circumferential pressure. Provide tools and dies as recommended by the manufacturer. Use an

embossing die code or other standard method to provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.13.3 Ground Bus

Provide a copper ground bus in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of electrical equipment: effectively grounded by bonding to the ground bus. Bond the ground bus to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Make connections and splices of the brazed, welded, bolted, or pressure-connector type, except use pressure connectors or bolted connections for connections to removable equipment.

3.1.13.4 Resistance

Maximum resistance-to-ground of grounding system: do not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.13.5 Telecommunications System

Provide telecommunications grounding in accordance with the following:

- a. Telecommunications Grounding Busbars: Provide a Primary bonding 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.

3.1.14 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications and are provided under the section specifying the associated equipment.

3.1.15 Elevator

Provide circuit to line terminals of elevator controller, and disconnect switch on line side of controller, outlet for control power, outlet receptacle and work light at midheight of elevator shaft, and work light and outlet receptacle in elevator pit.

3.1.16 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 Arc-Fault Receptacle Test

Test arc-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 1699.

3.5.6 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.

3.5.7 Watthour Meter

a. Visual and mechanical inspection

- (1) Examine for broken parts, shipping damage, and tightness of connections.
- (2) Verify that meter type, scales, and connections are in accordance with approved shop drawings.

b. Electrical tests

- (1) Determine accuracy of meter.
- (2) Calibrate watthour meters to one-half percent.
- (3) Verify that correct multiplier has been placed on face of meter, where applicable.

3.5.8 Phase Rotation Test

Perform phase rotation test to ensure proper rotation of service power prior to operation of new or reinstalled equipment using a phase rotation meter. Follow the meter manual directions performing the test.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 24 13

SWITCHBOARDS

08/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Product Data
 - 1.5.2 Switchboard Drawings
 - 1.5.3 Regulatory Requirements
 - 1.5.4 Standard Products
 - 1.5.4.1 Alternative Qualifications
 - 1.5.4.2 Material and Equipment Manufacturing Date
- 1.6 MAINTENANCE
 - 1.6.1 Switchboard Operation and Maintenance Data
 - 1.6.2 Assembled Operation and Maintenance Manuals
- 1.7 WARRANTY

PART 2 PRODUCTS

- 2.1 PRODUCT COORDINATION
- 2.2 SWITCHBOARD
 - 2.2.1 Ratings
 - 2.2.2 Construction
 - 2.2.2.1 Enclosure
 - 2.2.2.2 Bus Bars
 - 2.2.2.3 Distribution Sections
 - 2.2.3 Protective Device
 - 2.2.3.1 Molded-Case Circuit Breaker
 - 2.2.4 Electronic Trip Units
- 2.3 MANUFACTURER'S NAMEPLATE
- 2.4 FIELD FABRICATED NAMEPLATES
- 2.5 SOURCE QUALITY CONTROL
 - 2.5.1 Switchboard Design Tests
 - 2.5.1.1 Design Tests
 - 2.5.2 Switchboard Production Tests
- 2.6 COORDINATED POWER SYSTEM PROTECTION
- 2.7 ARC FLASH WARNING LABEL
- 2.8 SERVICE ENTRANCE AVAILABLE FAULT CURRENT LABEL

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 INSTALLATION OF EQUIPMENT AND ASSEMBLIES
 - 3.2.1 Switchboard
 - 3.2.2 Meters and Instrument Transformers

- 3.2.3 Field Applied Painting
- 3.2.4 Galvanizing Repair
- 3.2.5 Field Fabricated Nameplate Mounting
- 3.3 FOUNDATION FOR EQUIPMENT AND ASSEMBLIES
- 3.3.1 Interior Location
- 3.4 FIELD QUALITY CONTROL
- 3.4.1 Performance of Acceptance Checks and Tests
 - 3.4.1.1 Switchboard Assemblies
 - 3.4.1.2 Circuit Breakers
 - 3.4.1.3 Current Transformers
 - 3.4.1.4 Metering and Instrumentation
 - 3.4.1.5 Grounding System
- 3.4.2 Follow-Up Verification

-- End of Section Table of Contents --

SECTION 26 24 13

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; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489 (2016; Rev 2019) UL Standard for Safety
Molded-Case Circuit Breakers, Molded-Case
Switches and Circuit-Breaker Enclosures

UL 891 (2005; Reprint Oct 2012) Switchboards

1.2 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Switchboard Drawings; G

SD-03 Product Data

Switchboard; G

SD-06 Test Reports

Switchboard Design Tests; G

Switchboard Production Tests; G

Acceptance Checks and Tests; G

SD-10 Operation and Maintenance Data

Switchboard Operation and Maintenance, Data Package 5; G

SD-11 Closeout Submittals

Assembled Operation and Maintenance Manuals; G

Service Entrance Available Fault Current Label; G

1.5 QUALITY ASSURANCE

1.5.1 Product Data

Include manufacturer's information on each submittal for each component, device and accessory provided with the switchboard including:

- a. Circuit breaker type, interrupting rating, and trip devices, including available settings.
- b. Manufacturer's instruction manuals and published time-current curves (in electronic format) of the main secondary breaker and largest secondary feeder device.

1.5.2 Switchboard Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Identify circuit terminals on wiring diagrams and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Indicate on the drawings adequate clearance for operation, maintenance, and replacement of operating equipment devices. Include the nameplate data, size, and capacity on submittal. Also include applicable federal, military, industry, and technical society publication references on submittals. Include the following:

- a. One-line diagram including breakers.
- 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. Design test reports.

f. 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: as indicated.
- b. Continuous current rating of the main bus: as indicated.
- c. Short-circuit current rating: as indicated.
- d. UL listed and labeled as service entrance equipment.

2.2.2 Construction

Provide the following:

- a. Switchboard: consisting of one or more vertical sections bolted together to form a rigid assembly and rear aligned as indicated.
- b. All circuit breakers: front accessible.
- c. 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: copper with silver-plated contact surfaces.
 - (1) Phase bus bars: uninsulated.
 - (2) Neutral bus: rated 100 percent of the main bus continuous current rating as indicated.
- 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 Distribution Sections

Provide the distribution section consisting of individually mounted, 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, standard rated branch breakers, manually operated, low voltage molded-case circuit breaker, with a short-circuit current rating of as indicated.
- b. Breaker frame size: as indicated.
- c. Series rated circuit breakers are unacceptable.

2.2.4 Electronic Trip Units

Equip main breakers with a solid-state tripping system consisting of three current sensors and a microprocessor-based trip unit that provides true rms sensing adjustable time-current circuit protection. Include the following:

- a. Current sensors ampere rating: the same as the breaker frame rating.
- b. Trip unit ampere rating: as indicated.
- c. Ground fault protection: as indicated.
- d. Electronic trip units: provide additional features:

- (1) Main breakers: include short delay pick-up and time settings, instantaneous settings and ground fault settings as indicated.

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 Switchboard Design Tests

NEMA PB 2 and UL 891.

2.5.1.1 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.

2.5.2 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

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.

3.4.1.2 Circuit Breakers

Low Voltage - Insulated-Case and Low Voltage Molded Case with Solid State Trips

a. Visual and Mechanical Inspection

- (1) Compare nameplate data with specifications and approved shop drawings.
- (2) Inspect circuit breaker for correct mounting.
- (3) Operate circuit breaker to ensure smooth operation.
- (4) Inspect case for cracks or other defects.
- (5) Inspect all bolted electrical connections for high resistance using low resistance ohmmeter, verifying tightness of accessible bolted connections and/or cable connections by calibrated torque-wrench method, or performing thermographic survey.
- (6) Inspect mechanism contacts and arc chutes in unsealed units.

b. Electrical Tests

- (1) Perform contact-resistance tests.
- (2) Perform insulation-resistance tests.
- (3) Perform Breaker adjustments for final settings in accordance with Government provided settings.
- (4) Perform long-time delay time-current characteristic tests
- (5) Determine short-time pickup and delay by primary current injection.
- (6) Determine ground-fault pickup and time delay by primary current injection.
- (7) Determine instantaneous pickup current by primary injection.
- (8) Verify correct operation of any auxiliary features such as trip and pickup indicators, zone interlocking, electrical close and trip operation, trip-free, and anti-pump function.

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 watt-hour 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.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 27 13.10 30

ELECTRIC METERS

10/07, CHG 2: 08/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Installation Drawings
 - 1.4.2 Standard Products
 - 1.4.3 Alternative Qualifications
 - 1.4.4 Material and Equipment Manufacturing Data
- 1.5 WARRANTY
- 1.6 SYSTEM DESCRIPTION
 - 1.6.1 System Requirements
 - 1.6.2 Selection Criteria

PART 2 PRODUCTS

- 2.1 POWER METERS
 - 2.1.1 Physical and Common Requirements
 - 2.1.2 Voltage Requirements
 - 2.1.3 Current Requirements
 - 2.1.4 Electrical Measurements
 - 2.1.5 Meter Accuracy
 - 2.1.6 An on the Meter Display, Output and Reading Capabilities
 - 2.1.7 Installation Methods
 - 2.1.8 Disconnecting Switches
 - 2.1.9 Meter Programming
- 2.2 COMMUNICATIONS
 - 2.2.1 Communications Methods
 - 2.2.1.1 Serial Port
 - 2.2.1.2 Ethernet
 - 2.2.2 Communications Protocols and Methods
 - 2.2.3 Communications Channels Surge Protection
- 2.3 METER DATA PROTOCOL
 - 2.3.1 Open Protocol
- 2.4 SPARE PARTS
 - 2.4.1 Parts List

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Performance of Acceptance Checks and Tests
 - 3.2.1.1 Meter Assembly
 - 3.2.1.2 Current Transformers
 - 3.2.1.3 Potential Transformers

Joint Cryptologic Center Building - Buckley SFB, CO

BU81

3.2.2 Follow-Up System Function Verification

3.2.3 Training

-- End of Section Table of Contents --

SECTION 26 27 13.10 30

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) 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 C12.20 | (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; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code |
|---------|---|

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification and on the drawings shall be 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 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:

- a. Maintenance manual shall provide:
 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-02 Shop Drawings

SD-03 Product Data

Power Meters; G

Current Transformers; G

Potential Transformer; G

Communications Module; G

Protocol Modules; G

Data Recorder; G

Submittals shall 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

SD-10 Operation and Maintenance Data

Power Meters; G

Communications Module; G

Protocol Modules; G

SD-11 Closeout Submittals

System Function Verification; G

1.4 QUALITY ASSURANCE

1.4.1 Installation Drawings

Drawings shall indicate but not be 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,.

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. 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.

1.4.3 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

Products manufactured more than 2 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.5 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.

1.6 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 method. Every building site

identified shall include sufficient metering components to measure the electrical parameters identified and to store and communicate the values as required in the following sections. Contractor shall 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. Metering system components shall be installed according to the Metering System Schedule shown on the drawings.
- b. Power meter shall be panel-mounted design. Meters shall be semi-flush, back-connected, dustproof, draw-out switchboard type. Cases shall have window removable covers capable of being sealed against tampering. Meters shall be of a type that can be withdrawn through approved sliding contacts from fronts of panels or doors without opening current-transformer secondary circuits, disturbing external circuits, or requiring disconnection of any meter leads. Necessary test devices shall be incorporated within each meter and shall provide means for testing either from an external source of electric power or from associated instrument transformers or bus voltage.
- c. Meter shall be a Class 20, transformer rated design.
- d. Meter shall be rated for use at temperature from -40 degrees Centigrade to +70 degrees Centigrade.
- e. Meter shall have NEMA 3R enclosure for surface mounting.
- f. Surge withstand shall conform to IEEE C37.90.1.
- g. Meter shall have a standard 4-year warranty.
- h. Meter shall comply 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. Meter shall be capable of connection to the service voltage phases and magnitude being monitored. If the meter is not rated for the service voltage, provide suitable potential transformers to send an acceptable voltage to the meter.
- b. Meter shall be capable of connection to the service voltage indicated in the Metering System Schedule:
- c. Meter shall accept independent voltage inputs from each phase. Meter shall be auto-ranging over the full range of input voltages.
- d. Voltage input shall be optically isolated to 2500 volts DC from signal and communications outputs. Components shall meet or exceed IEEE C37.90.1 (Surge Withstand Capability).

- e. The Contractor shall be responsible for determining the actual voltage ratio of each potential transformer. Transformer shall conform 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. Meter shall accept independent current inputs from each phase. Current transformer shall be installed with a full load rating as shown in the schedule.
- b. Single ratio current transformer shall have an Accuracy Class of 0.6 with a maximum error of +/- 0.6% at 5.0 amps.
- c. Current transformer shall have:
 - 1. Insulation Class: All 600 volt and below current transformers shall be rated 10 KV BIL. Current transformers for 2400 and 4160 volt service shall be rated 25 KV BIL.
 - 2. Frequency: Nominal 60Hz, 50Hz for bases that operate on 50Hz.
 - 3. Burden: Burden class shall be selected for the load.
 - 4. Phase Angle Range: 0 to 60 degrees.
- d. Meter shall accept current input from standard instrument transformers (5A secondary current transformers.)
- e. Current inputs shall have a continuous rating in accordance with IEEE C57.13.
- f. Multi-ratio current transformer where indicated shall have a top range equal to or greater than the actual load. The Contractor shall be responsible for determining the actual ratio of each transformer. Current transformer shall conform to IEEE C57.13.

2.1.4 Electrical Measurements

Power meter shall 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.

2.1.5 Meter Accuracy

Power meter shall provide the following accuracies. Accuracies shall be measured as percent of reading at standard meter test points.

- a. Power meter shall meet 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

Meter shall include the following output signals.

- a. The meter will have a face display plate and shall display every electrical parameter indicated to be recorded. Meters shall not be required to indicate interval data collected in a data logger with a communications output feature. Peak values, instantaneous and cumulative values shall be displayed.

2.1.7 Installation Methods

- a. Building mounted ("BLDG" in Metering Systems Schedule)

- 1. Meter base shall be mounted on the side of the existing building near the service entrance. See detail on the drawings.

- b. Panel mounted. ("PNL" in Metering Systems Schedule)

- 1. Meter shall be mounted where directed. See detail on the drawings.

- c. Common features.

- 1. PTs (if required for proper voltage range) and CTs shall be physically connected to the service entrance cables inside the service entrance disconnect enclosure.

2.1.8 Disconnecting Switches

- a. Disconnecting wiring blocks shall be provided between the current transformer and the meter. A shorting mechanism shall be built into the wiring block to allow the current transformer wiring to be changed without removing power to the transformer. The wiring blocks shall be located 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. Voltage-monitoring circuits shall be equipped with disconnect switches to isolate the meter base or socket from the voltage source.

2.1.9 Meter Programming

- a. Power meter shall be programmable by software supplied by the meter manufacturer.
- b. Software shall have a user-friendly, Windows-compatible interface.

- c. Software shall operate on Windows operating systems.
- d. Software shall allow the user to configure the meter, troubleshoot meter, query and display meter parameters and configuration data and stored values.
- e. Meter firmware shall be 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 Serial Port

Provide serial port for connection to modem module where required in this specification.

a. On-Board serial port types

- 1. RS232
- 2. RS485

2.2.1.2 Ethernet

For those meters using the Ethernet, logged information shall be sent 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

Communications protocols and methods shall be native to the meter. Provide communications module(s) as required to accomplish the following.

- a. Meter shall 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. Meter shall include one RS-232 ("RS232" in Metering Systems Schedule) or one RS-485 digital communication port. Each port shall be user configurable with regard to speed, protocol, address, and other communications parameters. Ports shall support a minimum communication speed of 9600 baud for the RS232 port.
- c. Meter shall have a port that can be configured as a 10/100 Base-T

Ethernet port ("BaseT" in Metering Systems Schedule)

1. A communication module that converts serial RS232 or RS485 to Ethernet will be acceptable.

2.2.3 Communications Channels Surge Protection

Communications equipment shall be protected against surges induced on its communications channels. Communication interfaces to all field equipment shall be protected 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. Fuses shall not be used for surge protection. Metallic cables and conductors which serve as communications channels between buildings shall have surge protection installed at equipment rated for the application installed at each end, within 3 feet of the building cable entrance. Surge protectors shall meet the requirements of the applicable extension of ANSI C62 (for example, ANSI C62.61).

2.3 METER DATA PROTOCOL

Power meters shall have communicating data protocols native or provided in supplemental modules to communicate with the communications methods that follow.

2.3.1 Open Protocol

Power meter shall support the following open protocols. Contractor shall verify that the meter native protocol is consistent with the facility data recording and communication and data storage system. Contractor shall provide additional converters and modules as required for a complete measurement, recording, communicating and data storage system.

- a. Meter must be compatible with the building automation system (BAS). The meter must be provided with BACnet communication protocol communication protocol capabilities, to allow integration with the BAS. Coordinate communication requirement with the BAS supplier.

Systems capable of using more than one brand of commercially available meters are expected.

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.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, NFPA 70, and to the requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.2 FIELD QUALITY CONTROL

3.2.1 Performance of Acceptance Checks and Tests

3.2.1.1 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

1. Verify that correct multiplier has been placed on face or meter where applicable.
2. Prior to system acceptance, the Contractor will demonstrate and confirm the meter is properly wired and is displaying correct and accurate electrical information.

3.2.1.2 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.

3.2.1.3 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.

3.2.2 Follow-Up System Function Verification

Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that circuits and devices are in good operating condition and properly performing the intended function. As an exception to requirements stated elsewhere in the contract, the Contracting Officer shall be given 5 working days' advance notice of the dates and times of checking and testing.

3.2.3 Training

The Contractor shall conduct a training course for meter configuration, operation, and maintenance of the system as specified. The training shall be oriented for all components and systems installed under this contract. Training manuals shall be delivered for 6 trainees with two additional copies delivered for archiving at the project site. The Contractor shall 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, the Contractor shall assume that attendees have a high school education or equivalent, and are familiar with utility systems. Approval of the planned training schedule shall be obtained from the Government at least 30 days prior to the training.

- a. Training: The course shall be taught 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 shall include:

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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 28 01.00 10

COORDINATED POWER SYSTEM PROTECTION

08/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
- 1.3 SUBMITTALS

PART 2 PRODUCTS

- 2.1 COORDINATED POWER SYSTEM PROTECTION
 - 2.1.1 Scope of Analyses
 - 2.1.2 Determination of Facts
 - 2.1.3 Single Line Diagram
 - 2.1.4 Fault Current Analysis
 - 2.1.4.1 Method
 - 2.1.4.2 Data
 - 2.1.4.3 Fault Current Availability
 - 2.1.5 Coordination Study
 - 2.1.6 Arc Flash Analysis
 - 2.1.7 Study report

PART 3 EXECUTION

-- End of Section Table of Contents --

SECTION 26 28 01.00 10

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

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: A dedicated building service transformer, rated at 500kVA, 13.2kV-480/277V, 3-Phase; an underground service from the service transformer to a main switchboard located in the main electrical room; branch circuit panelboards; and a centralized inverter to provide emergency power to emergency lights.

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-03 Product Data

Fault Current Analysis

Protective Device Coordination Study

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 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 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.

2.1.1.1 Scope of Analyses

The fault current analysis and protective device coordination study must begin at: the source bus and extend down to system buses where fault availability is 10,000 amperes (symmetrical) for building/facility 600 volt level distribution buses.

2.1.1.2 Determination of Facts

Determine and document the time-current characteristics, features, and nameplate data for each existing protective device. Coordinate with the commercial power company for fault current availability at the site.

2.1.1.3 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.

2.1.1.4 Fault Current Analysis

2.1.1.4.1 Method

Perform the fault current analysis in accordance with methods described in IEEE 242, and IEEE 399.

2.1.1.4.2 Data

Utilize actual data in fault calculations. Bus characteristics and transformer impedance must be those proposed. Document data in the report.

2.1.1.4.3 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.

2.1.6 Arc Flash Analysis

Provide Arc Flash analysis and labeling in accordance with NFPA 70E, IEEE Std 1584, and Army Core of Engineers Standard EM 385-1-1.

2.1.7 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 utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers 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.

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 29 23

ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS

02/20, CHG 1: 05/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 SYSTEM DESCRIPTION
 - 1.3.1 Performance Requirements
 - 1.3.1.1 Electromagnetic Interference Suppression
 - 1.3.1.2 Electromechanical and Electrical Components
 - 1.3.2 Electrical Requirements
 - 1.3.2.1 Power Line Surge Protection
 - 1.3.2.2 Sensor and Control Wiring Surge Protection
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Schematic Diagrams
 - 1.5.2 Interconnecting Diagrams
 - 1.5.3 Installation Drawings
 - 1.5.4 Equipment Schedule
 - 1.5.5 Installation Instructions
 - 1.5.6 Standard Products
- 1.6 DELIVERY AND STORAGE
- 1.7 WARRANTY
- 1.8 MAINTENANCE
 - 1.8.1 Spare Parts
 - 1.8.2 Operation and Maintenance Data
 - 1.8.3 Maintenance Support
 - 1.8.4 Technical Support

PART 2 PRODUCTS

- 2.1 ADJUSTABLE SPEED DRIVES (ASD)
 - 2.1.1 ASD for HVAC Application
- 2.2 ENCLOSURES
- 2.3 WIRES AND CABLES
- 2.4 NAMEPLATES
- 2.5 SOURCE QUALITY CONTROL
 - 2.5.1 ASD Test Plan
 - 2.5.2 ASD Test Report

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 GROUNDING
- 3.3 FIELD QUALITY CONTROL
 - 3.3.1 ASD Test
 - 3.3.2 Performance Verification Tests
 - 3.3.3 Endurance Test

3.4 DEMONSTRATION

3.4.1 Training

3.4.1.1 Instructions to Government Personnel

3.4.1.2 Operating Personnel Training Program

3.4.1.3 Engineering/Maintenance Personnel Training

-- End of Section Table of Contents --

SECTION 26 29 23

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	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
---------	--

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices
-----------	-------------------------

UNDERWRITERS LABORATORIES (UL)

UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 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 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

Schematic Diagrams; G
Interconnecting Diagrams; G
Installation Drawings; G
As-Built Drawings; G

SD-03 Product Data

Adjustable Speed Drives; G
Wires and Cables
Equipment Schedule

SD-06 Test Reports

ASD Test
Performance Verification Tests
Endurance Test

SD-07 Certificates

Testing Agency's Field Supervisor NETA Certificate; G

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

ASD Test Plan; G

Standard Products

SD-10 Operation and Maintenance Data

Adjustable Speed Drives, Data Package 4

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Submit diagrams showing circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the functional assemblies.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation Drawings

Show floor plan of each site, with ASD's and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes. Submit drawings for government approval prior to equipment construction or integration. Immediately record modifications to original drawings made during installation for inclusion into the as-built drawings.

1.5.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule must provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule must include the total quantity of each item of equipment supplied and data indicating compatibility with motors being driven. For complete assemblies, such as ASD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.5.5 Installation Instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.5.6 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

- a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.
- b. Have been on sale on the commercial market through advertisements,

manufacturers' catalogs, or brochures during the 2-year period.

- c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6 DELIVERY AND STORAGE

Store delivered equipment to protect from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 WARRANTY

The complete system must be warranted by the manufacturer for a period of one year. Repair or replace any component failing to perform its function as specified and documented at no additional cost to the Government. Items repaired or replaced must be warranted for an additional period of at least one year from the date that it becomes functional again, as specified in FAR 52.246-21 Warranty of Construction.

1.8 MAINTENANCE

1.8.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

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 a 208 volt, 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 have sensor in each phase, Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing, Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting, analog communication module, NC and NO isolated overload alarm contact, external overload, reset push button.
- 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 properly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of ASD failure and for safety transfers motor between power converter output and bypass circuit using a field-selectable automatic and manual bypass mode. 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.

2.1.1.1 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 4-20 mA and 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 engaging a qualified testing agency's field supervisor currently certified by NETA to supervise on-site testing.

3.3.2 Performance Verification Tests

"Performance Verification Test" plan must provide the step by step procedure required to establish formal verification of the performance of the ASD. Compliance with the specification requirements must be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. Inform the Government 14 calendar days prior to the date the test is to be conducted.

3.3.3 Endurance Test

Immediately upon completion of the performance verification test, the endurance test must commence. The system must be operated at varying rates for not less than 192 consecutive hours, at an average effectiveness level of 0.9998, to demonstrate proper functioning of the complete PCS. Continue the test on a day-to-day basis until performance standard is met. The contractor is not allowed in the building during the endurance test. The system must respond as designed.

3.4 DEMONSTRATION

3.4.1 Training

Coordinate training requirements with the Contracting Officer. Provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. Provide all training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the contracting officer.

3.4.1.1 Instructions to Government Personnel

Provide the services of competent instructors with minimum two-year field experience with the operation and maintenance of similar ASDs who will give full instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors must be thoroughly familiar with the subject matter they are to teach. The number of training days of instruction furnished must be as specified. A training day is defined as eight hours of instruction,

including two 15-minute breaks and excluding lunch time; Monday through Friday. Provide a training manual for each student at each training phase which describes in detail the material included in each training program. Provide one additional copy for archiving. Provide equipment and materials required for classroom training. Provide a list of additional related courses, and offers, noting any courses recommended. List each training course individually by name, including duration, approximate cost per person, and location of course. Unused copies of training manuals must be turned over to the Government at the end of last training session.

3.4.1.2 Operating Personnel Training Program

Provide one 2-hour training session at the site at a time and place mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

- a. System overview
- b. General theory of operation
- c. System operation
- d. Alarm formats
- e. Failure recovery procedures
- f. Troubleshooting

3.4.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training must be conducted on site at a location designated by the Government. Provide a one-day training session to train four engineering personnel in the functional operations of the system. This training must include:

- a. System overview
- b. General theory of operation
- c. System operation
- d. System configuration
- e. Alarm formats
- f. Failure recovery procedures
- g. Troubleshooting and repair
- h. Maintenance and calibration
- i. System programming and configuration

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM

11/13

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
 - 1.2.1 Verification of Dimensions
 - 1.2.2 System Requirements
 - 1.2.3 Lightning Protection System Installers Documentation
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Installation Drawings
 - 1.4.1.1 Overall System Drawing
 - 1.4.1.2 Major Components
 - 1.4.2 Component UL Listed and Labeled
 - 1.4.3 Lightning Protection and Grounding System Test Plan
 - 1.4.4 Lightning Protection System Inspection Certificate
- 1.5 SITE CONDITIONS

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Main and Bonding Conductors
 - 2.1.2 Copper Only
- 2.2 COMPONENTS
 - 2.2.1 Air Terminals
 - 2.2.2 Ground Rods
 - 2.2.3 Connections and Terminations
 - 2.2.4 Connector Fittings

PART 3 EXECUTION

- 3.1 INTEGRAL SYSTEM
 - 3.1.1 Roof-Mounted Components
 - 3.1.1.1 Air Terminals
 - 3.1.1.2 Roof Conductors
 - 3.1.2 Down Conductors
 - 3.1.3 Ground Connections
 - 3.1.4 Grounding Electrodes
- 3.2 APPLICATIONS
 - 3.2.1 Nonmetallic Exterior Walls with Metallic Roof
- 3.3 RESTORATION
- 3.4 FIELD QUALITY CONTROL
 - 3.4.1 Lightning Protection and Grounding System Test

-- End of Section Table of Contents --

SECTION 26 41 00

LIGHTNING PROTECTION SYSTEM
11/13

PART 1 GENERAL

1.1 REFERENCES

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

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81 (2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 780 (2020) Standard for the Installation of Lightning Protection Systems

UNDERWRITERS LABORATORIES (UL)

UL 96 (2016) UL Standard for Safety Lightning Protection Components

UL 467 (2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment

UL Electrical Construction (2012) Electrical Construction Equipment Directory

1.2 RELATED REQUIREMENTS

1.2.1 Verification of Dimensions

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before making any departures from the design.

1.2.2 System Requirements

Provide a system furnished under this specification consisting of the latest UL Listed products of a manufacturer regularly engaged in production of lightning protection system components. Comply with NFPA 70, NFPA 780, and UL 96.

1.2.3 Lightning Protection System Installers Documentation

Provide documentation showing that the installer is certified with a commercial third-party inspection company whose sole work is lightning protection, or is a UL Listed Lightning Protection Installer. In either case, the documentation must show that they have completed and passed the requirements for certification or listing, and have a minimum of 2 years documented experience installing lightning protection systems for DoD projects of similar scope and complexity.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for 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

Overall lightning protection system; G

Each major component; G

SD-06 Test Reports

Lightning Protection and Grounding System Test Plan; G

Lightning Protection and Grounding System Test; G

SD-07 Certificates

Lightning Protection System Installers Documentation; G

Component UL Listed and Labeled; G

Lightning protection system inspection certificate; G

Roof manufacturer's warranty; G

1.4 QUALITY ASSURANCE

In each standard referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" or "must" has been substituted for "should" wherever it appears. Interpret references in these standards to "authority having jurisdiction," or words of similar meaning, to mean Contracting Officer.

1.4.1 Installation Drawings

1.4.1.1 Overall System Drawing

Submit installation shop drawing for the overall lightning protection system. Include on the drawings the physical layout of the equipment (plan view and elevations), mounting details, relationship to other parts of the work, and wiring diagrams.

1.4.1.2 Major Components

Submit detail drawings for each major component including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions.

1.4.2 Component UL Listed and Labeled

Submit proof of compliance that components are UL Listed and Labeled. Listing alone in UL Electrical Construction, which is the UL Electrical Construction Directory, is not acceptable evidence. In lieu of Listed and Labeled, submit written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that items have been tested and conform to requirements and testing methods of Underwriters Laboratories.

1.4.3 Lightning Protection and Grounding System Test Plan

Provide a lightning protection and grounding system test plan. Detail both the visual inspection and electrical testing of the system and components in the test plan. Identify (number) the system test points/locations along with a listing or description of the item to be tested and the type of test to be conducted. As a minimum, include a sketch of the facility and surrounding lightning protection system as part of the specific test plan for each structure. Include the requirements specified in paragraph, "Testing of Integral Lightning Protection System" in the test plan.

1.4.4 Lightning Protection System Inspection Certificate

Provide certification from a commercial third-party inspection company whose sole work is lightning protection, stating that the lightning protection system complies with NFPA 780. Third party inspection company cannot be the system installer or the system designer. Alternatively, provide a UL Lightning Protection Inspection Master Label Certificate for each facility indicating compliance to NFPA 780.

Inspection must cover every connection, air terminal, conductor, fastener, accessible grounding point and other components of the lightning protection system to ensure 100% system compliance. This includes witnessing the tests for the resistance measurements for ground rods with test wells, and for continuity measurements for bonds. It also includes verification of proper surge protective devices for power, data and telecommunication systems. Random sampling or partial inspection of a facility is not acceptable.

1.5 SITE CONDITIONS

Confirm all details of work, verify all dimensions in field, and advise Contracting Officer of any discrepancy before performing work. Obtain prior approval of Contracting Officer before changing the design.

PART 2 PRODUCTS

2.1 MATERIALS

Do not use a combination of materials that forms an electrolytic couple of such nature that corrosion is accelerated in the presence of moisture unless moisture is permanently excluded from the junction of such metals.

Where unusual conditions exist which would cause corrosion of conductors, provide conductors with protective coatings, such as tin or lead, or oversize conductors. Where a mechanical hazard is involved, increase conductor size to compensate for the hazard or protect conductors. When metallic conduit or tubing is provided, electrically bond conductor to conduit or tubing at the upper and lower ends by clamp type connectors or welds (including exothermic). All lightning protection components, such as bonding plates, air terminals, air terminal supports and braces, chimney bands, clips, connector fittings, and fasteners are to comply with the requirements of UL 96 classes as applicable.

2.1.1 Main and Bonding Conductors

NFPA 780 and UL 96 Class I, Class II, or Class II modified materials as applicable.

2.1.2 Copper Only

Provide copper conductors, except where aluminum conductors are required for connection to aluminum equipment.

2.2 COMPONENTS

2.2.1 Air Terminals

Provide solid air terminals with a blunt tip. Tubular air terminals are not permitted. Support air terminals more than 24 inches in length by suitable brace, supported at not less than one-half the height of the terminal.

2.2.2 Ground Rods

Provide ground rods made of copper-clad steel conforming to conform to UL 467. Provide ground rods that are not less than 3/4 inch in diameter and 10 feet in length. Do not mix ground rods of copper-clad steel or solid copper on the job.

2.2.3 Connections and Terminations

Provide connectors for splicing conductors that conform to UL 96, class as applicable. Conductor connections can be made by clamps or welds (including exothermic). Provide style and size connectors required for the installation.

2.2.4 Connector Fittings

Provide connector fittings for "end-to-end", "Tee", or "Y" splices that conform to NFPA 780 and UL 96.

PART 3 EXECUTION

3.1 INTEGRAL SYSTEM

Provide a lightning protection system that meets the requirements of NFPA 780. Lightning protection system consists of air terminals, roof conductors, down conductors, ground connections, 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. Do not penetrate roof when installing lighting protection components on roof.

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. Down conductors are to be concealed within the wall cavities.

3.1.3 Ground Connections

Attach each down conductor and ground ring electrode to ground rods by welding (including exothermic), brazing, or compression. All connections to ground rods below ground level must be by exothermic weld connection or with a high compression connection using a hydraulic or electric compression tool to provide the correct circumferential pressure. Accessible connections above ground level can be accomplished by mechanical clamping.

Down conductor terminations at test wells must be done using mechanical connectors.

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 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.

3.4 FIELD QUALITY CONTROL

3.4.1 Lightning Protection and Grounding System Test

Test the lightning protection and grounding system to ensure continuity is not in excess of 1 ohm and that resistance to ground is not in excess of 25 ohms. Provide documentation for the measured values at each test point. Test the ground rod for resistance to ground before making connections to the rod. Tie the grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not earlier than 48 hours after rainfall. Include in the written report: locations of test points, measured values for continuity and ground resistances, and soil conditions at the time that measurements were made. Submit results of each test to the Contracting Officer.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 42 13

GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM

05/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Cathodic Protection
 - 1.2.2 Corrosion
 - 1.2.3 Alternating Current (AC) Corrosion
 - 1.2.4 AC Interference
 - 1.2.5 Uniform Attack
 - 1.2.6 Galvanic or Two-Metal Corrosion
 - 1.2.7 Crevice Corrosion
 - 1.2.8 Pitting Corrosion
 - 1.2.9 Intergranular Corrosion
 - 1.2.10 Selective Leaching
 - 1.2.11 Erosion Corrosion
 - 1.2.12 Stress-Corrosion Cracking
 - 1.2.13 Exothermic Welding
 - 1.2.14 Error-Free
- 1.3 ADMINISTRATIVE REQUIREMENTS
- 1.4 SUBMITTALS
 - 1.4.1 Material and Equipment Manufacturer Data
- 1.5 MAINTENANCE MATERIAL SUBMITTALS
 - 1.5.1 Spare Parts
 - 1.5.2 Extra Materials
- 1.6 QUALITY CONTROL
 - 1.6.1 Regulatory Requirements
 - 1.6.2 Qualifications
 - 1.6.3 Services of Corrosion Expert
- 1.7 DELIVERY, STORAGE AND HANDLING
- 1.8 PROJECT/SITE CONDITIONS
 - 1.8.1 Environmental Requirements
 - 1.8.2 Existing Conditions
- 1.9 WARRANTY

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Corrosion Control System Description
 - 2.1.2 Design Requirements
 - 2.1.2.1 Electrical Isolators
 - 2.1.2.2 Non-metallic Pipe System
 - 2.1.2.3 Coatings
 - 2.1.2.4 Tracer Wire
 - 2.1.2.5 Drawings
 - 2.1.2.6 Summary of Services Required
 - 2.1.2.7 Tests of Components

- 2.1.2.8 Electrical Potential Measurements
- 2.1.2.9 Typical Metallic Components on Non-metallic Systems
 - 2.1.2.9.1 Metallic Components
 - 2.1.2.9.2 Fire Hydrants
 - 2.1.2.9.3 Pipe Beneath Concrete Slab
 - 2.1.2.9.4 Valves
 - 2.1.2.9.5 Connectors or Change-of-Direction Devices
- 2.1.2.10 Metallic Component Coating
- 2.1.2.11 Location of Test Stations
- 2.1.2.12 Electrical Isolation of Structures
 - 2.1.2.12.1 Gas Distribution Piping
 - 2.1.2.12.2 Isolation Joint Testing
 - 2.1.2.12.3 Underground Structure Coating
 - 2.1.2.12.4 Field Joints
 - 2.1.2.12.5 Inspection of Pipe Coatings
 - 2.1.2.12.6 Protective Coating for Aboveground Piping System
 - 2.1.2.12.7 Ferrous Surfaces
- 2.1.3 Performance Requirements
 - 2.1.3.1 Criteria of Cathodic Protection
 - 2.1.3.1.1 Steel
 - 2.1.3.1.2 Aluminum
 - 2.1.3.1.3 Copper Piping
- 2.2 EQUIPMENT
 - 2.2.1 Corrosion Rate Monitoring
 - 2.2.2 Polarization Cell Replacement (PCR) and (PCRH) for Hazardous Locations
 - 2.2.3 Solid State Decoupler (SSD)
- 2.3 COMPONENTS
 - 2.3.1 Test Stations
 - 2.3.1.1 Flush Mounted
 - 2.3.2 Shunts for Test Stations and Junction Boxes
 - 2.3.3 Junction Box Enclosures
 - 2.3.3.1 Nameplates
 - 2.3.4 Terminal Boards
 - 2.3.5 Anode Junction Boxes
 - 2.3.5.1 Enclosure
 - 2.3.5.2 Terminal Boards
- 2.4 MATERIALS
 - 2.4.1 Galvanic Anodes
 - 2.4.1.1 Dimensions and Weights
 - 2.4.1.2 Magnesium Anodes
 - 2.4.1.2.1 Packaged Anodes
 - 2.4.1.3 Cast Zinc Anodes
 - 2.4.1.3.1 Anode Composition
 - 2.4.2 Wire and Cable
 - 2.4.2.1 Anode Lead Wire
 - 2.4.2.2 Anode Header Cable
 - 2.4.2.3 Structure (Negative) Cable
 - 2.4.2.4 Test Wires
 - 2.4.2.5 Joint and Continuity Bond Cables
 - 2.4.2.6 Resistance Bond Wires
 - 2.4.3 Cable and wire Identification Tags
 - 2.4.4 AC Mitigation Materials
 - 2.4.5 Backfill Material
 - 2.4.6 Permanent Reference Electrodes
 - 2.4.7 Pavement Inserts
 - 2.4.8 Coupons
 - 2.4.9 Isolation Flange Kits
 - 2.4.9.1 Gaskets

- 2.4.9.2 Isolating Washers and Sleeves
- 2.4.9.3 Washers
- 2.4.10 Steel Flanges and Bolting
 - 2.4.10.1 Steel Flanges
 - 2.4.10.2 Bolting
- 2.4.11 Dielectric Unions
- 2.4.12 Isolation and End Seals
 - 2.4.12.1 Casing Isolator/Centralizer
 - 2.4.12.2 End Seals
- 2.5 ACCESSORIES
 - 2.5.1 Conduit
 - 2.5.2 Joint, Patch, Seal, and Repair Coating
 - 2.5.3 Underground Splices
 - 2.5.3.1 Cast-Type Splice
 - 2.5.3.2 Gravity-Poured Splice
 - 2.5.3.3 Heat Shrinkable Splice
 - 2.5.4 Electrical Isolation of Structures
 - 2.5.4.1 Electrically Isolating Pipe Joints
 - 2.5.4.2 Electrically Isolating Couplings
 - 2.5.5 Electrical Insulating Coating
 - 2.5.6 Buried Cable Warning and Identification Tape
 - 2.5.7 Electrical Connection to Structures
 - 2.5.7.1 Exothermic Welds
 - 2.5.7.2 Electrical-Shielded Arc Welds
 - 2.5.7.3 Brazing
 - 2.5.8 Electrical Tape
 - 2.5.9 Exothermic Weld Kits
- 2.6 TESTS, INSPECTIONS, AND VERIFICATIONS
 - 2.6.1 Non-Destructive Testing of Anodes

PART 3 EXECUTION

- 3.1 SAFETY PRECAUTIONS AND HAZARDOUS LOCATIONS
- 3.2 INSTALLATION
 - 3.2.1 Excavation and Trenching
 - 3.2.2 Anode Excavation
 - 3.2.3 Lead Wire Trench
- 3.3 ANODES AND LEAD WIRE
 - 3.3.1 Anode Installation
 - 3.3.1.1 Single Anodes
 - 3.3.1.2 Group of Anodes
- 3.4 INSTALLATION DETAILS
 - 3.4.1 Anode Installation
 - 3.4.2 Lead Wire Installation
 - 3.4.2.1 Lead Wire Connections
 - 3.4.2.2 Field Drawing
 - 3.4.2.3 Metallic Underground Pipeline Connection
 - 3.4.3 Underground Pipe Joint Bonds
 - 3.4.4 Anode Junction Boxes
 - 3.4.5 Bonding Boxes
 - 3.4.6 Test Stations and Permanent Reference Electrodes
 - 3.4.7 Permanent Reference Electrode Verification
 - 3.4.7.1 Field Drawings
- 3.5 ELECTRICAL ISOLATION OF STRUCTURES
 - 3.5.1 Isolation Fittings
 - 3.5.2 Dielectric Unions
 - 3.5.3 Gas Distribution Piping
 - 3.5.4 Joint Bonds
 - 3.5.5 Casings, Isolation, and Seals

3.6 FIELD QUALITY CONTROL

3.6.1 Tests and Measurements

- 3.6.1.1 Native Potentials
- 3.6.1.2 Protected Potentials
- 3.6.1.3 Isolation Testing
- 3.6.1.4 Isolation Tester
- 3.6.1.5 Anode Output
- 3.6.1.6 Reference Electrode Potential Measurements
- 3.6.1.7 Casing Tests
- 3.6.1.8 Holiday Test
- 3.6.1.9 Stray Current Measurements
- 3.6.1.10 Induced AC Testing
- 3.6.1.11 Interference Tests
- 3.6.1.12 Initial Cathodic Protection System Field Testing
- 3.6.1.13 Government Field Testing
- 3.6.1.14 One-Year-Warranty-Period-Testing
- 3.6.1.15 Final Acceptance Field Testing

3.7 CLOSEOUT ACTIVITIES

3.7.1 Reconditioning of Surfaces

- 3.7.1.1 Concrete
- 3.7.1.2 Restoration of Sod
- 3.7.1.3 Restoration of Pavement
- 3.7.1.4 Cleanup

3.7.2 Training

- 3.7.2.1 Instruction to Government Personnel

-- End of Section Table of Contents --

SECTION 26 42 13

GALVANIC (SACRIFICIAL) ANODE CATHODIC PROTECTION (GACP) SYSTEM
05/21

PART 1 GENERAL

1.1 REFERENCES

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

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, 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 B418	(2016a; R2021) Standard Specification for Cast and Wrought Galvanic Zinc Anodes
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 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 Cathodic Protection

Cathodic Protection (CP) is an electrochemical (half electrical and half chemical) method used to control corrosion of buried or submerged metallic structures. It prevents corrosion by making the protected structure a cathode by installing a more anodic metal (sacrificial or galvanic) anode or a metallic (impressed current) anode connected to a Direct Current (DC) power source. When the proper amount of current is applied to the structure, it becomes a cathode. Since all corrosion occurs at the anode, the structure no longer corrodes. The electrons move in the metallic path (electrical). Reduction (chemical) reactions occur at the surface of the cathode resulting in a hydrogen coating and more alkaline environment. Oxidation (chemical) reactions occur at the surface of the anode resulting in corrosion and a more acidic environment. After a CP system is installed and adjusted to provide adequate protection, the hydrogen coats the defects in the coating and polarizes in the negative direction (to a copper/copper sulfate reference electrode) over time the current and potentials remain relatively stable; changes in currents or potentials indicate a problem. An error-free measurement of negative 850 millivolts DC or more negative to the copper/copper-sulfate reference electrode proves the structure is a cathode and corrosion has been mitigated.

1.2.2 Corrosion

It is convenient to classify corrosion by the forms in which it manifests itself, the basis for this classification being the appearance of the corroded metal. Each form can be identified by visual observation, although, in some cases, magnification is required. Valuable information for the solution of a corrosion problem can often be obtained through careful observation of the corroded test specimens or failed equipment. Examination before cleaning is particularly desirable. Some of the eight forms of corrosion are unique, but all of them are more or less interrelated.

The eight forms of corrosion are: (1) Uniform Attack, (2) Galvanic or Two-Metal Corrosion, (3) Crevice Corrosion, (4) Pitting Corrosion, (5) Intergranular Corrosion, (6) Selective Leaching, (7) Erosion Corrosion, and (8) Stress Corrosion Cracking. This listing is arbitrary but covers practically all corrosion failures and problems. The forms are not listed in any particular order of importance. Below, the eight forms of corrosion are discussed in terms of their characteristics, mechanisms, and preventive measures. Hydrogen damage, although not a form of corrosion,

often occurs indirectly as a result of corrosive attack and is, therefore, included in this discussion.

1.2.3 Alternating Current (AC) Corrosion

AC corrosion occurs when there is a source of AC current, typically from a high voltage overhead AC (OHAC) power-line, when there is a low soil resistivity - typically less than 5,000 ohm-cm and there is a very small coating holidays. The AC corrosion pits typically have a tubercle of corrosion product at the pit. AC interference study modeling software can determine the mitigation solution to solve this problem. Typically, AC Corrosion mitigation is done in conjunction with high AC potentials and fault current mitigation.

1.2.4 AC Interference

AC interference occurs when a pipeline parallels a high-voltage overhead AC (OHAC) power-line. An interference study is required when this situation occurs as AC interference can cause high AC potentials along the pipeline (safety), can cause a fault condition between the pipeline and power-line and could cause AC corrosion to occur. The pipeline coating when exposed can have blisters/bubbles caused by the excessive AC. The interference study will use modeling software to determine what combination of interference may be occurring (if any) and provide the mitigation solution to solve the problem.

1.2.5 Uniform Attack

Uniform attack is the most common form of corrosion. It is normally characterized by a chemical or electrochemical reaction that proceeds uniformly over the entire exposed surface or over a large area. The metal becomes thinner and eventually fails. For example, a piece of steel or zinc immersed in dilute sulfuric acid normally dissolves at a uniform rate over its entire surface. A sheet iron roof shows essentially the same degree of rusting over its entire outside surface.

Uniform attack, or general overall corrosion, represents the greatest destruction of metal on a tonnage basis. This form of corrosion, however, is not of great concern from a technical standpoint, because the life of equipment can be accurately estimated on the basis of comparatively simple tests. Merely immersing specimens in the fluid involved is often sufficient. Uniform attack can be prevented or reduced by (1) materials, such as coatings, that reduce contact between metal and electrolytes, (2) inhibitors, or (3) CP.

1.2.6 Galvanic or Two-Metal Corrosion

A potential difference usually exists between two dissimilar-metals when they are immersed in a corrosive or conductive solution. If these metals are placed in contact (or otherwise electrically connected), this potential difference produces electron flow between them. Corrosion of the less corrosion-resistant metal is usually increased, and attack of the more resistant material is decreased, compared to the behavior of these metals when they are not in contact. The less resistant metal becomes anodic and the more resistant metal becomes cathodic. Usually the cathode or cathodic metal corrodes very little or not at all in this type of couple. Because of the electric currents and dissimilar-metals involved, this form of corrosion is called galvanic, bi-metallic or two-metal, corrosion. Galvanic corrosion is restricted to electrochemical corrosion

caused by dissimilar-metal effects. It is electrochemical corrosion, but this document must restrict the term galvanic to dissimilar-metal effects for purposes of clarity.

1.2.7 Crevice Corrosion

Intense localized corrosion frequently occurs within crevices and other shielded areas on metal surfaces exposed to corrosives. This type of attack is usually associated with small volumes of stagnant solution caused by holes, gasket surfaces, lap joints, surface deposits, and crevices under bolt and rivet heads. As a result, this form of corrosion is called crevice corrosion or, sometimes, deposit or gasket corrosion.

1.2.8 Pitting Corrosion

Pitting is a form of extremely localized attack that results in holes in the metal. These holes may be small or large in diameter, but in most cases they are relatively small. Pits are sometimes isolated or so close together that they look like a rough surface. Generally a pit may be described as a cavity or hole with the surface diameter about the same as or less than the depth. Pitting is one of the most destructive and insidious forms of corrosion. It causes equipment to fail because of perforation with only a small percent weight loss of the entire structure. It is often difficult to detect pits because of their small size and because the pits are often covered with corrosion products. In addition, it is difficult to measure quantitatively and compare the extent of pitting because of the varying depths and numbers of pits that may occur under identical conditions. Pitting is also difficult to predict by laboratory tests. Sometimes the pits require a long time (several months or a year) to show up in actual service. Pitting is particularly vicious because it is a localized and intense form of corrosion, and failures often occur with extreme suddenness.

1.2.9 Intergranular Corrosion

Grain boundary effects are of little or no consequence in most applications or uses of metals. If a metal corrodes, uniform attack results since grain boundaries are usually only slightly more reactive than the matrix. However, under certain conditions, grain interfaces are very reactive and intergranular corrosion results. Localized attack at and adjacent to grain boundaries, with relatively little corrosion of the grains, is intergranular corrosion. The alloy disintegrates (grains fall out) or loses its strength. Intergranular corrosion can be caused by impurities at the grain boundaries, enrichment of one of the alloying elements, or depletion of one of these elements in the grain-boundary areas. Small amounts of iron in aluminum, wherein the solubility of iron is low, have been shown to segregate in the grain boundaries and cause intergranular corrosion. It has been shown that, based on surface tension considerations, the zinc content of a brass is higher at the grain boundaries. Depletion of chromium in the grain-boundary regions results in intergranular corrosion of stainless steels.

1.2.10 Selective Leaching

Selective leaching is the removal of one element from a solid alloy by corrosion processes. The most common example is the selective removal of zinc in brass alloys (dezincification). Similar processes occur in other alloy systems in which aluminum, iron, cobalt, chromium, and other elements are removed. Selective leaching is the general term to describe

these processes, and its use precludes the creation of terms such as de-aluminumification, de-cobaltification. Parting is a metallurgical term that is sometimes applied, but selective leaching is preferred.

1.2.11 Erosion Corrosion

Erosion corrosion is the acceleration or increase in rate of deterioration or attack on a metal because of relative movement between a corrosive fluid and the metal surface. Generally, this movement is quite rapid, and mechanical wear effects or abrasion are involved. Metal is removed from the surface as dissolved ions, or it forms solid corrosion products, which are mechanically swept from the metal surface. Sometimes, movement of the environment decreases corrosion, particularly when localized attack occurs under stagnant conditions; this is not erosion corrosion because deterioration is not increased. Erosion corrosion is characterized in appearance by grooves, gullies, waves, rounded holes, and valleys and usually exhibits a directional pattern. In many cases, failures because of erosion corrosion occur in a relatively short time, and they are unexpected largely because evaluation corrosion tests were run under static conditions or because the erosion effects were not considered.

1.2.12 Stress-Corrosion Cracking

Stress-corrosion cracking refers to cracking caused by the simultaneous presence of tensile stress and a specific corrosive medium. Many investigators have classified all cracking failures occurring in corrosive media as stress-corrosion cracking, including failures due to hydrogen embrittlement. However, these two types of cracking failures respond differently to environmental variables. To illustrate, CP is an effective method for preventing stress-corrosion cracking; however, hydrogen-embrittlement may be caused when excessive current is applied, especially on stainless steel. Hence, the importance of considering stress-corrosion cracking and hydrogen embrittlement as separate phenomena is obvious. During stress-corrosion cracking, the metal or alloy is virtually unattacked over most of its surface, while fine cracks progress through it. This cracking phenomenon has serious consequences, since it can occur at stresses within the range of typical design stress.

1.2.13 Exothermic Welding

Exothermic welding is used in CP to connect a copper wire to a metallic structure, usually steel or cast-iron. It is a pyrotechnic composition of copper oxide, aluminum powder and magnesium powder. The magnesium powder is ignited with a spark gun or electronic ignition equipment. The aluminum powder serves as fuel, and melts the copper oxide, which bonds the wire to the structure. Although not explosive, it can create brief bursts of heat and high temperature in a small area.

1.2.14 Error-Free

Potential measurement error due to a voltage drop caused by current flowing through a resistor (the electrolyte) between the reference electrode and the protected structure.

1.3 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

Isolation flange kits

Anode junction boxes, bonding boxes, and test stations

Joint bonds

Contractor's Modifications; G

SD-03 Product Data

Qualifications

Equipment; G

Anodes; G

Anode junction boxes, bonding boxes, and test stations

Dielectric unions

Wires

Cable and wire

Casings, isolation, and seals

Shunts

Permanent reference electrodes; G

Spare Parts

SD-06 Test Reports

Tests and Measurements; G

Contractor's Modifications; G

SD-10 Operation and Maintenance Data

Cathodic Protection System; G

Training Course; G

Cathodic Protection System, Data Package 5; G

SD-11, Closeout Submittals

Initial Cathodic Protection System Field Testing; G

One Year Warranty Period Cathodic Protection System Field Test Report; G

Final Cathodic Protection System Field Test Report; G

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 with 350 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 certification or licensing that includes education and experience in CP of the type of CP system being installed. The corrosion expert must have not less than 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 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 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.

2.1.2.3 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.

2.1.2.4 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.

2.1.2.5 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.

2.1.2.6 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.

2.1.2.7 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.

2.1.2.8 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.

2.1.2.9 Typical Metallic Components on Non-metallic Systems

2.1.2.9.1 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 30 pounds. Locate the galvanic anodes on each side of the metallic component and route through a test station.

2.1.2.9.2 Fire Hydrants

Provide fire hydrant pipe components with a minimum of two anodes. These galvanic anodes must have an unpackaged weight of 30 pounds.

2.1.2.9.3 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 30 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.

2.1.2.9.4 Valves

Protect each valve with 2 galvanic anodes. The galvanic anode must have

an unpackaged weight of 30 pounds.

2.1.2.9.5 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 30 pounds.

2.1.2.10 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.

2.1.2.11 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.

2.1.2.12 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 gas 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.

2.1.2.12.1 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.

2.1.2.12.2 Isolation Joint Testing

An isolator checker or insulation tester will be used for isolation or insulating joint (flange or dielectric) electrical testing.

2.1.2.12.3 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.

2.1.2.12.4 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.

2.1.2.12.5 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.

2.1.2.12.6 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:

2.1.2.12.7 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 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.

2.2.2 Polarization Cell Replacement (PCR) and (PCRH) for Hazardous Locations

PCRs and PCRHs 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.

Characteristic	PCR	PCRH
AC steady-state current, rms	45A, 80A	45A
AC fault current, rms. at 0.5s	3.7 kA to 15 kA	3.7 kA to 15 kA
Lightning current, 8x20 micros, peak	100 kA	100 kA
Hazardous location certification	Division 2, Zone 2	Division 1, Zone 1
Rain Proof, IP66	Yes	Yes
Submersible, IP68 or NEMA 6P	Optional	No

PCRs must be installed with a protective ground-based enclosure to secure the cable connections and prevent electrical hazards. The PCRH must be installed with an explosion-proof enclosure and must be flange mounted. Structure and Grounding conductors must be properly sized for the application.

AC Fault Current Rating	Minimum Wire Size (AWG)	Minimum Wire Size (Metric)
1.2 kA, 2kA, 3.7 kA	#6	16mm ²
5kA 9kA 10kA	#2	35mm ²

AC Fault Current Rating	Minimum Wire Size (AWG)	Minimum Wire Size (Metric)
14kA 15kA	#2/0	70mm ²

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, clamped cover, and padlocked hasp. 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 Section 26 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, clamped cover. and padlocked hasp. 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 30 pounds not including core.

2.4.1.2 Magnesium Anodes

2.4.1.2.1 Packaged Anodes

Provide anodes in packaged form with the anode surrounded by specially-prepared quick-wetting backfill and contained in a water permeable cloth or paper sack. Anodes must be centered by means of spacers in the backfill material.

The backfill material will have the following composition, unless otherwise indicated:

Material	Approximate Percent by Weight
Gypsum	75
Bentonite	20
Sodium Sulfate	5
Total	100

2.4.1.3 Cast Zinc Anodes

ASTM B418, Type II. Bare anode weight: 30 pounds not including core.

Typical Zinc Bare Anode Sizes and Packaged Weight									
Bare Weight		Width		Height		Length		Total Packaged Weight	
kg	pounds	mm	inches	mm	inches	mm	inches	kg	pounds
	30		2.0		2.0		30		67

2.4.1.3.1 Anode Composition

Chemical composition as follows:

Zinc	4.5 percent maximum
Indium	0.02 percent maximum
Silicon	0.01 percent maximum
Aluminum	Remainder

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, 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 HMWP, 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 HMWPE 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, HMWPE 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 gas.

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/CuSO ₄ 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 Negative 1.0 Volts DC

Failure of the test anode to conform to this specification can be cause for rejecting all anodes from the same lot as the test anode. The contractor must mark all rejected anodes on the ends with a 6 inch high "X" using yellow spray paint. Failed anodes must be removed from the job site by the end of the day. The contractor must replace any rejected anodes at the contractor's expense. The destructive testing provision must also apply to replacement anodes as well.

PART 3 EXECUTION

3.1 SAFETY PRECAUTIONS AND HAZARDOUS LOCATIONS

Any personnel performing operations that will generate heat, sparks, or flame in hazardous locations must first perform adequate safety precautions. A trained responsible person must ensure the area is safe to perform the operation. Required actions include ensuring adequate ventilation before work starts, air monitoring, and a fire watch must be provided and remain for 30 minutes after the operation is completed. A minimum of 20 pound ABC type fire extinguisher must be available and must be inspected before each use. Equipment being used must be inspected and used in accordance with manufacturer recommendations. Combustibles that are in the work area(s) must be moved or if they cannot be moved, be covered with fire retardant welding blankets. When performing exothermic welding, properly sized charges and inspection of the structure condition must be accomplished to ensure a safe operation.

3.2 INSTALLATION

3.2.1 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 exceeding six 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 of 6 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 Gas Distribution Piping

Electrical isolation will be provided 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. If an isolating joint is located inside a vault, the pipe must be sleeved when entering and leaving the vault. A non-metallic sleeve is to be used.

3.5.4 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.

3.5.5 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), at intervals not exceeding 400 feet with readings at each end point and the midpoints as a minimum. 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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 51 00

INTERIOR LIGHTING

05/20, CHG 1: 05/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Luminaire Drawings
 - 1.5.2 Luminaire Design Data
 - 1.5.3 ANSI/IES LM-79 Test Report
 - 1.5.4 ANSI/IES LM-80 Test Report
 - 1.5.5 ANSI/IES TM-21 Test Report
 - 1.5.6 ANSI/IES TM-30 Test Report
 - 1.5.7 LED Driver and Dimming Switch Compatibility Certificate
 - 1.5.8 Test Laboratories
 - 1.5.9 Regulatory Requirements
 - 1.5.10 Standard Products
 - 1.5.10.1 Alternative Qualifications
 - 1.5.10.2 Material and Equipment Manufacturing Date
- 1.6 WARRANTY
 - 1.6.1 Luminaire Warranty
 - 1.6.2 Lighting Controls Warranty
- 1.7 OPERATION AND MAINTENANCE MANUALS
 - 1.7.1 Lighting System
 - 1.7.2 Lighting Control System

PART 2 PRODUCTS

- 2.1 PRODUCT COORDINATION
- 2.2 LUMINAIRES
 - 2.2.1 Luminaires
- 2.3 LIGHT SOURCES
 - 2.3.1 LED Light Sources
- 2.4 LED DRIVERS
- 2.5 LIGHTING CONTROLS
 - 2.5.1 System
 - 2.5.1.1 Localized Control Systems
 - 2.5.1.1.1 Local Area Controller
 - 2.5.2 Devices
 - 2.5.2.1 Switches
 - 2.5.2.2 Wall Box Dimmers
 - 2.5.2.3 Scene Wallstations
 - 2.5.2.4 Occupancy/Vacancy Sensors
 - 2.5.2.4.1 Passive Infrared Sensors
 - 2.5.2.4.2 Ultrasonic Sensors
 - 2.5.2.4.3 Dual Technology Sensors

- 2.5.2.4.4 Integrated Sensors
- 2.5.2.4.5 Power Packs
- 2.5.2.5 Photosensors
- 2.5.2.6 Time Clocks
- 2.6 EXIT AND EMERGENCY LIGHTING EQUIPMENT
 - 2.6.1 Exit Signs
 - 2.6.1.1 Remote-Powered Exit Signs
 - 2.6.2 Central Emergency Lighting System
 - 2.6.2.1 Operation
 - 2.6.2.2 Charger
 - 2.6.2.3 Batteries
 - 2.6.2.4 Accessories
 - 2.6.2.5 Enclosure
- 2.7 LUMINAIRE MOUNTING ACCESSORIES
 - 2.7.1 Suspended Luminaires
 - 2.7.2 Recess and Surface Mounted Luminaires
 - 2.7.3 Luminaire Support Hardware
 - 2.7.3.1 Wire
 - 2.7.3.2 Wire for Humid Spaces
 - 2.7.3.3 Threaded Rods
 - 2.7.3.4 Straps
 - 2.7.4 Power Hook Luminaire Hangers
- 2.8 EQUIPMENT IDENTIFICATION
 - 2.8.1 Manufacturer's Nameplate
 - 2.8.2 Labels
- 2.9 FACTORY APPLIED FINISH

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Light Sources
 - 3.1.2 Luminaires
 - 3.1.2.1 Suspended Luminaires
 - 3.1.2.2 Recessed and Semi-Recessed Luminaires
 - 3.1.2.3 Field Applied Painting
 - 3.1.3 LED Drivers
 - 3.1.4 Exit Signs
 - 3.1.5 Lighting Controls
 - 3.1.5.1 Scene Wallstations
 - 3.1.5.2 Occupancy/Vacancy Sensors
 - 3.1.5.3 Photosensors
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Tests
 - 3.2.1.1 Lighting Control Verification Tests
 - 3.2.1.2 Emergency Lighting Test
- 3.3 CLOSEOUT ACTIVITIES
 - 3.3.1 Commissioning
 - 3.3.2 Training
 - 3.3.2.1 Maintenance Staff Training
 - 3.3.2.2 End-User Training

-- End of Section Table of Contents --

SECTION 26 51 00

INTERIOR LIGHTING
05/20, 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.

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	(2020) 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	(2019) Technical Memorandum: Projecting Long-Term Lumen, 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) Occupancy Motion Sensors Standard

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 101 (2021) Life Safety Code

NFPA 110 (2022) Standard for Emergency and Standby Power Systems

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 May 2021) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

UL 508 (2018) UL Standard for Safety Industrial Control Equipment

UL 916 (2015) Standard for Energy Management Equipment

UL 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) Luminaires

UL 2043 (2013) Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces

UL 8750 (2015; Reprint Jan 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. Cybersecurity requirements are specified in Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS. Commissioning requirements for Army and Air Force projects are specified in Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING.

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 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

Luminaire Drawings; G

Occupancy/Vacancy Sensor Coverage Layout; G; S

Lighting Control System One-Line Diagram; G

Sequence of Operation for Lighting Control System; G

SD-03 Product Data

Luminaires; G

Light Sources; G

LED Drivers; G
Luminaire Warranty; G
Lighting Controls Warranty; G
Local Area Controller; G
Switches; G
Wall Box Dimmers; G
Scene Wallstations; G
Occupancy/Vacancy Sensors; G
Photosensors; G
Time Clocks; G
Power Packs; G
Power Hook Luminaire Hangers; G
Exit Signs; G

SD-05 Design Data

Luminaire Design Data; G

SD-06 Test Reports

ANSI/IES LM-79 Test Report; G
ANSI/IES LM-80 Test Report; G
ANSI/IES TM-21 Test Report; G
ANSI/IES TM-30 Test Report; G
Occupancy/Vacancy Sensor Verification Test; G
Photosensor Verification Test; G

SD-07 Certificates

LED Driver and Dimming Switch Compatibility Certificate; G

SD-10 Operation and Maintenance Data

Lighting System, Data Package 5; G
Lighting Control System, Data Package 5; G
Maintenance Staff Training Plan; G
End-User Training Plan; G

1.5 QUALITY ASSURANCE

Data, drawings, and reports must employ the terminology, classifications

and methods prescribed by the IES 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 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.

1.5.9 Regulatory Requirements

Equipment, materials, installation, and workmanship must be in accordance with the mandatory and advisory provisions of NFPA 70, unless more stringent requirements are specified or indicated. Provide luminaires and assembled components that are approved by and bear the label of UL for the applicable location and conditions unless otherwise specified.

1.5.10 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design, and workmanship. Products must have been in satisfactory commercial or industrial use for six months prior to bid opening. The six-month period must include applications of equipment and materials under similar circumstances and of similar size. The product must have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the six-month period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.10.1 Alternative Qualifications

Products having less than a six-month field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.10.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than six months prior to date of delivery to site, unless specified otherwise.

1.6 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.6.1 Luminaire Warranty

Provide and transfer to the government the original LED luminaire manufacturers standard commercial warranty for each different luminaire manufacturer used in the project.

- a. Provide a written five year minimum replacement warranty for material, luminaire finish, and workmanship. Provide written warranty document that contains all warranty processing information needed, including customer service point of contact, whether or not a return authorization number is required, return shipping information, and closest return location to the luminaire location.

- (1) Finish warranty must include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

- (2) Material warranty must include:

- (a) All LED drivers and integral control equipment.

- (b) Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective, non-starting, or operating below 70 percent of specified lumen output.

- b. Warranty period must begin in accordance with the manufacturer's standard warranty starting date.

- c. Provide replacements that are promptly shipped, without charge, to the using Government facility point of contact and that are identical to or an improvement upon the original equipment. All replacements must include testing of new components and assembly.

1.6.2 Lighting Controls Warranty

Provide and transfer to the government the original lighting controls manufacturers standard commercial warranty for each different lighting controls manufacturer used in the project. Warranty coverage must begin from date of final system commissioning or three months from date of delivery, whichever is the earliest. Warranty service must be performed by a factory-trained engineer or technician.

- a. Unless otherwise noted, provide a written five year minimum warranty on the complete system for all systems with factory commissioning. Provide warranty that covers 100 percent of the cost of any replacement parts and services required over the five years which are directly attributable to the product failure. Failures include, but are not limited to, the following:

- (1) Software: Failure of input/output to execute switching or dimming commands.

- (2) Damage of electronic components due to transient voltage surges.

- (3) Failure of control devices, including but not limited to occupancy sensors, photosensors, and manual wall station control devices.

- b. Provide a written five year minimum warranty on all input devices against defect in workmanship or materials provided by device manufacturer.

- c. Provide a written five year minimum warranty on all control components attached to luminaires against defect in workmanship or materials.

1.7 OPERATION AND MAINTENANCE MANUALS

1.7.1 Lighting System

Provide operation and maintenance manuals for the lighting system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting system for the building. Additional O&M Manual requirements for the Army are provided in Section 01 78 24.00 10 FACILITY DATA REQUIREMENTS. Additional requirements for the Navy are provided in Section 01 78 24.00 20 FACILITY ELECTRONIC OPERATION AND MAINTENANCE SUPPORT INFORMATION (eOMSI). Include the following:

- a. Manufacturers' operating and maintenance manuals.
- b. Luminaire shop drawings for modified and custom luminaires.
- c. Luminaire Manufacturers' standard commercial warranty information as specified in paragraph LUMINAIRE WARRANTY.

1.7.2 Lighting Control System

Provide operation and maintenance manuals for the lighting control system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting control system for the building. Include the following:

- a. Lighting control system layout and wiring plan.
- b. Lighting control system one-line diagram.
- c. Product data for all devices, including installation and programming instructions.
- d. Occupancy/vacancy sensor coverage layout.
- e. Training materials, such as videos or in-depth manuals, that cover basic operation of the lighting control system and instructions on modifying the lighting control system. Training materials must include calibration, adjustment, troubleshooting, maintenance, repair, and replacement.
- f. Sequence of operation descriptions for each typical room type, including final programming, schedules, and calibration settings.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

2.2 LUMINAIRES

UL 1598, NEMA C82.77-10. Provide luminaires as indicated in the luminaire schedule and NL plates or details on project plans, complete with light source, wattage, and lumen output indicated. All luminaires of the same type must be provided by the same manufacturer. Luminaires must be

specifically designed for use with the driver and light source provided.

2.2.1 Luminaires

UL 8750, 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, Accent (undercabinet, cove)	45 LPW
Linear, Ambient (indirect wall mount, linear pendent)	100 LPW
High Bay, Low Bay, and Industrial Locations	100 LPW
Food Service and Hazardous Locations	60 LPW
Other (track, residential diffusers)	50 LPW
Exterior Wall Sconce	50 LPW
Steplight	30 LPW
Parking Garage Luminaire	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

- i. For all recessed luminaires that are identified to be in contact with insulation, provide luminaires that are IC-rated.
- j. For all recessed luminaires that are to be installed in air plenums, require housings that are Chicago Plenum rated.

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 3500 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 4 kV without impairment of performance. Provide surge protection that is integral to the driver.
- g. Integral thermal protection that reduces the output power to protect the driver and light source from damage if the case temperature approaches or exceeds the driver's maximum operating temperature.
- h. 47 CFR 15. Complies with the requirements of the Federal Communications Commission (FCC) rules and regulations, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
- i. Class A sound rating.
- j. 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 10 percent. Dimmable drivers must be controlled by a Class 2 low voltage 0-10VDC controller dimming signal protocol unless otherwise specified. LED drivers of the same family/series must track evenly across multiple luminaires at all light levels.

2.5 LIGHTING CONTROLS

Provide network certification for all networked lighting control systems and devices in accordance with the requirements of Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS. Provide lighting control systems that do not switch off battery-operated or emergency backup luminaires or exit signs in path of egress. Provide system with override of lighting control devices controlling luminaires in path of egress with activation of fire alarm system.

2.5.1 System

Provide lighting control system that operates the lighting system as described in the lighting control strategies in the project plans. Submit Sequence of Operation for Lighting Control System describing the operation of the proposed lighting control system and devices. Sequence of Operation must provide the strategies identified in the lighting control strategies.

2.5.1.1 Localized Control Systems

Provide room or area-wide lighting control system capable of manual control, time-based control, and receiving input from photosensors and occupancy/vacancy sensors.

2.5.1.1.1 Local Area Controller

Provide controller designed for single area or room with the following requirements:

- a. Operates at a voltage of 120-277 volts at 50/60 hertz.
- b. 2 zone, with 2 relays rated 20 amps each with one manual 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 for spaces with access to daylight.
- 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.

2.5.2 Devices

2.5.2.1 Switches

Provide line-voltage toggle switches as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. When used for non-digital loads, devices must be rated at 20 Amps inductive load, and be compatible with the lighting control systems.

2.5.2.2 Wall Box Dimmers

UL 1472, UL 20, IEEE C62.41, NEMA 77, NEMA SSL 7A. Dimmers must provide flicker-free, continuously variable light output throughout the dimming range of 10 percent to 100 percent. Devices must be capable of operating at their full rated capacity regardless of being single or ganged-mounted, and be compatible with three-way and four-way switching scenarios.

Provide wall-box dimmers that meet the following requirements:

- a. Device operates as part of a lighting control system.
- b. Device operates with the use of a vertical slider, paddle, rotary, button, or toggle with adjacent vertical slider.
- c. Finish of device matches switches and outlets in the same area.
- d. Back box in wall has sufficient depth to accommodate body of switch and wiring.
- e. Dimmer is capable of controlling 0-10 volt LED drivers. Dimmers and the drivers they control must be provided from the same manufacturer or tested and certified as compatible for use together.
- f. Radio frequency interference suppression is integral to device.

2.5.2.3 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.

2.5.2.4 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 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 mounted.
- d. Shielded or controlled by internal logic to adjust sensitivity to avoid false triggering due to ambient temperature, air temperature variations or HVAC air movement.
- e. Sensor is equipped to automatically energize the connected load upon loss of normal power when located in a means of egress.
- f. Occupancy and vacancy operation is field-adjustable and programmable via lighting control system processor.
- g. No leakage current to load when in the off mode.
- h. Utilize zero-crossing circuitry to prevent damage from high inrush current and to promote long life operation.
- i. Provide an isolated relay for integrating control of HVAC or other automated systems.

2.5.2.4.1 Passive Infrared Sensors

Provide Passive Infrared Sensors (PIR) sensors that detect occupancy by sensing heat and movement in the area of coverage. Provide sensors are constructed of a housing of high-impact, injection-molded thermoplastic. Provide PIR sensors that are temperature compensated, with a dual element sensor and a multi-element fresnel lens of POLY IR4 material.

2.5.2.4.2 Ultrasonic Sensors

Provide ultrasonic sensors that detect occupancy by sensing a change in pattern of reflected ultrasonic waves in the area of coverage. Provide

sensors that are constructed of a housing of high-impact, injection-molded thermoplastic. Provide ultrasonic sensors that operate at 40 kHz.

2.5.2.4.3 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.

2.5.2.4.4 Integrated Sensors

Provide integrated occupancy/vacancy sensors that mount directly to the luminaires as indicated in project plans.

2.5.2.4.5 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 12-24 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.

2.5.2.5 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 a closed-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.

2.5.2.6 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. Astronomic 24 hour programming function, providing a total of 56 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 seven days.
- d. Capable of controlling a minimum of 2 channels or loads.
- e. Contacts are rated for 30 amps at 120-277 VAC resistive load in a SPDT normally open (NO) configuration.
- f. Contains manual bypass or remote override control, daylight savings time automatic adjustment, EEPROM memory module, and ability 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 UV-stable, thermo-plastic.
- 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 Remote-Powered Exit Signs

Provide exit sign that contains provision for 120-277 VAC input from remote source.

2.6.2 Central Emergency Lighting System

UL 924, NFPA 101, NFPA 110 level 1, NFPA 70.. Provide a central power system providing emergency power at 208/120 volts, 60 hertz, for a minimum period of 90 minutes. Design the system to handle surges during loss and recovery of the voltage, and to deliver its full rated output to the designated lamp load. Provide batteries for power.

2.6.2.1 Operation

Provide system such that when the lighting system loses normal supply voltage, it automatically disengages itself from the normal input line, and switches to a self-contained inverter with built-in protection when the output is shorted or overloaded. Ensure that, when normal line voltage resumes, the emergency system automatically switches back to normal operation. Size the transfer switch for this function to handle 125 percent of full load. Provide the battery system with self-contained inverters with overload protection.

2.6.2.2 Charger

Provide a completely automatic battery charger that maintains the batteries in a fully charged condition and recharges the batteries to full capacity within 24 hours after full discharge in accordance with UL 924.

2.6.2.3 Batteries

Provide sealed lead-acid batteries, maintenance-free for a period of not less than 10 years under normal operating conditions.

2.6.2.4 Accessories

Provide visual indicators to indicate normal power, inverter power, and battery-charger operation. Provide a low-voltage test switch to simulate power failure by interrupting the input line, voltage meter, electrolyte level detector to automatically disable the charging circuit in the event of a fault, and low-voltage cutoff to prevent extreme battery power dissipation.

2.6.2.5 Enclosure

Provide a free-standing cabinet with floor stand and constructed of 2.7 millimeter 12 -gage sheet steel with baked-on enamel finish and a locking latch.

2.7 LUMINAIRE MOUNTING ACCESSORIES

2.7.1 Suspended Luminaires

- a. Provide hangers capable of supporting twice the combined weight of luminaires supported by hangers.
- b. Hangers must allow luminaires to swing within an angle of 45 degrees. Brace pendants 4 feet or longer to limit swinging.
- c. Single-unit suspended luminaires must have cable hangers. Multiple-unit or continuous row luminaires with a separate power supply cord must have a tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end.
- d. Provide all linear 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.

2.7.4 Power Hook Luminaire Hangers

UL 1598. Provide an assembly consisting of through-wired power hook housing, interlocking plug and receptacle, power cord, and luminaire support loop. Power hook housing must be cast aluminum having two 3/4 inch threaded hubs. Support hook must have safety screw. Luminaire support loop must be cast aluminum with provisions for accepting 3/4 inch threaded stems. Power cord must include 16 inches of 3 conductor No. 16 Type SO cord. Assembly must be rated 120 volts or 277 volts, 15 amperes.

2.8 EQUIPMENT IDENTIFICATION

2.8.1 Manufacturer's Nameplate

Each item of equipment must have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.8.2 Labels

UL 1598. All luminaires must be clearly marked for operation of specific light sources and LED drivers. The labels must be easy to read when standing next to the equipment, and durable to match the life of the equipment to which they are attached. Note the following light source characteristics in the format "Use Only _____":

- a. Correlated Color Temperature (CCT) and Color Rendering Index (CRI) for all luminaires.
- b. Driver and dimming protocol.

All markings related to light source type must be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when light sources are in place. LED drivers must have clear markings indicating dimming type and indicate proper terminals for the various outputs.

2.9 FACTORY APPLIED FINISH

NEMA 250. Provide all luminaires and lighting equipment with factory-applied painting system that as a minimum, meets requirements of corrosion-resistance testing.

PART 3 EXECUTION

3.1 INSTALLATION

IEEE C2, NFPA 70.

3.1.1 Light Sources

When light sources are not provided as an integral part of the luminaire, deliver light sources of the type, wattage, lumen output, color temperature (CCT), color rendering index (CRI), and voltage rating indicated to the project site and install just prior to project completion, if not already installed in the luminaires from the factory.

3.1.2 Luminaires

Set luminaires plumb, square, and level with ceiling and walls, in alignment with adjacent luminaires and secure in accordance with manufacturers' directions and approved drawings. Provide accessories as required for ceiling construction type indicated on Finish Schedule. Luminaire catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which a luminaire may be installed. Provide wires, straps, or rods for luminaire support in this section. Install luminaires with vent holes free of air blocking obstacles.

3.1.2.1 Suspended Luminaires

Measure mounting heights from the bottom of the luminaire for ceiling-mounted luminaires and to center of luminaire for wall-mounted luminaires. Obtain architect approval of the exact mounting height on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Support suspended luminaires from structural framework of ceiling or from inserts cast into slab.

- a. Provide suspended luminaires with 45 degree swivel hangers so that they hang plumb and level.
- b. Locate so that there are no obstructions within the 45 degree range in all directions.
- c. The stem, canopy and luminaire must be capable of 45 degree swing.
- d. Rigid pendent stem, aircraft cable, rods, or chains 4 feet or longer excluding luminaire must be braced to prevent swaying using three cables at 120 degree separation.
- e. Suspended luminaires in continuous rows must have internal wireway systems for end to end wiring and must be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces.
- f. Utilize aligning splines on extruded aluminum luminaires to assure minimal hairline joints.
- g. Support steel luminaires to prevent "oil-canning" effects.
- h. Match supporting pendants with supported luminaire. Aircraft cable must be stainless steel.
- i. Match finish of canopies to match the ceiling, and provide low profile canopies unless otherwise shown.
- j. Maximum distance between suspension points must be 10 feet or as recommended by the manufacturer, whichever is less.

3.1.2.2 Recessed and Semi-Recessed Luminaires

- a. Support recessed and semi-recessed luminaires independently from the building structure by a minimum of two wires, straps or rods per luminaire and located near opposite corners of the luminaire. Secure horizontal movement with clips provided by manufacturer. Ceiling grid clips are not allowed as an alternative to independently supported luminaires.
- b. Support round luminaires or luminaires smaller in size than the ceiling grid independently from the building structure by a minimum of four wires, straps or rods per luminaire, spaced approximately equidistant around.
- c. Do not support luminaires by acoustical tile ceiling panels.
- d. Where luminaires of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support each independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the luminaire.
- e. Luminaires installed in suspended ceilings must also comply with the requirements of Section 09 51 00 ACOUSTICAL CEILINGS.
- f. Adjust aperture rings on all applicable ceiling recessed luminaires to accommodate various ceiling material thickness. Coordinate cut-out size in ceiling to ensure aperture covers cut-out entirely. Install

aperture rings such that the bottom of the ring is flush with finished ceiling or not more than 1/16 inch above. Do not install luminaires such that the aperture ring extends below the finished ceiling surface.

- g. For luminaire recessed in plaster ceilings, provide plaster frames for setting. Install setting such that the bottom of the frame is flush with finished ceiling. Support luminaires with plaster frames utilizing yokes or leveling lugs. Do not mount luminaires or support elements to ducts or pipes. Yokes must support a luminaire by no fewer than two bolts each.

3.1.2.3 Field Applied Painting

Paint lighting equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Provide painting as specified in Section 09 90 00 PAINTS AND COATINGS.

3.1.3 LED Drivers

Provide LED drivers integral to luminaire as constructed by the manufacturer.

3.1.4 Exit Signs

NFPA 101. Wire exit signs and emergency lighting units ahead of the local switch, to the normal lighting circuit located in the same room or area.

Connect exit signs on separate circuits and serve from an emergency panel. Provide only one source of control, which would be the circuit breaker in the emergency panel. Paint source of control red and provide lockout capability.

3.1.5 Lighting Controls

Refer to Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS for additional lighting control installation requirements.

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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 26 - ELECTRICAL

SECTION 26 56 00

EXTERIOR LIGHTING

08/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
- 1.4 SUBMITTALS
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Drawing Requirements
 - 1.5.1.1 Luminaire Drawings
 - 1.5.1.2 Pole Drawings
 - 1.5.2 Luminaire Design Data
 - 1.5.3 ANSI/IES LM-79 Test Report
 - 1.5.4 ANSI/IES LM-80 Test Report
 - 1.5.5 ANSI/IES TM-21 Test Report
 - 1.5.6 Test Laboratories
 - 1.5.7 Regulatory Requirements
 - 1.5.8 Standard Products
 - 1.5.8.1 Alternative Qualifications
 - 1.5.8.2 Material and Equipment Manufacturing Date
- 1.6 DELIVERY, STORAGE, AND HANDLING OF POLES
 - 1.6.1 Aluminum Poles
 - 1.6.2 Steel Poles
- 1.7 WARRANTY
 - 1.7.1 Luminaire Warranty
 - 1.7.2 Pole Warranty
- 1.8 OPERATION AND MAINTENANCE MANUALS
 - 1.8.1 Lighting System
 - 1.8.2 Exterior Lighting Control System

PART 2 PRODUCTS

- 2.1 PRODUCT COORDINATION
- 2.2 LUMINAIRES
 - 2.2.1 Luminaires
- 2.3 LIGHT SOURCES
 - 2.3.1 LED Light Sources
- 2.4 LED DRIVERS
- 2.5 LIGHTING CONTROLS
 - 2.5.1 System
 - 2.5.1.1 Relay Panel
 - 2.5.2 Devices
 - 2.5.2.1 Photosensors
- 2.6 POLES
 - 2.6.1 Aluminum Poles
 - 2.6.2 Steel Poles
 - 2.6.3 Brackets and Supports

- 2.6.4 Pole Foundations
- 2.7 EQUIPMENT IDENTIFICATION
 - 2.7.1 Manufacturer's Nameplate
 - 2.7.2 Labels
- 2.8 FACTORY APPLIED FINISH

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Luminaires
 - 3.1.2 LED Drivers
 - 3.1.3 Field-Applied Painting
 - 3.1.4 Aluminum and Steel Poles
 - 3.1.5 Lighting Controls
 - 3.1.5.1 Photosensors
 - 3.1.5.2 Motion Sensors
 - 3.1.6 Grounding
- 3.2 FIELD QUALITY CONTROL
 - 3.2.1 Tests
 - 3.2.1.1 Lighting Control Verification Test
- 3.3 CLOSEOUT ACTIVITIES
 - 3.3.1 Training
 - 3.3.1.1 Maintenance Staff Training
 - 3.3.1.2 End-User Training

-- End of Section Table of Contents --

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.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO LTS (2013; Errata 2013) Standard
Specifications for Structural Supports for
Highway Signs, Luminaires and Traffic
Signals

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-16 (2017; Errata 2018; Supp 1 2018) Minimum
Design Loads and Associated Criteria for
Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M (2017) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products

ASTM A153/A153M (2016a) Standard Specification for Zinc
Coating (Hot-Dip) on Iron and Steel
Hardware

ASTM B108/B108M (2019) Standard Specification for
Aluminum-Alloy Permanent Mold Castings

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) 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	(2019) Technical Memorandum: Projecting Long-Term Lumen, 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)

ANSI C136.3	(2020) Roadway and Area Lighting Equipment - Luminaire Attachments
ANSI C136.13	(2020) Roadway and Area Lighting Equipment - Metal Brackets for Wood Poles
ANSI C136.21	(2014) American National Standard for Roadway and Area Lighting Equipment - Vertical Tenons Used with Post-Top-Mounted Luminaires
NEMA 250	(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

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 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 924 (2016; Reprint May 2020) UL Standard for Safety Emergency Lighting and Power Equipment

UL 1310 (2018) UL Standard for Safety Class 2 Power Units

UL 1598 (2021) Luminaires

UL 8750 (2015; Reprint Jan 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. Cybersecurity requirements are specified in Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS. Commissioning requirements for Army and Air Force projects are specified in Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING.

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 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

Luminaire Drawings; G

Pole Drawings; G

Sequence of Operation for Exterior Lighting Control System; G

SD-03 Product Data

Luminaires; G

Light Sources; G

LED Drivers; G

Luminaire Warranty; G

Pole Warranty; G

Photosensors; G

Poles; G

Brackets

SD-05 Design Data

Luminaire Design Data; G

SD-06 Test Reports

ANSI/IES LM-79 Test Report; G

ANSI/IES LM-80 Test Report; G

ANSI/IES TM-21 Test Report; G

SD-08 Manufacturer's Instructions

Poles

SD-10 Operation and Maintenance Data

Lighting System, Data Package 5; G

Exterior Lighting Control System, Data Package 5; G

Maintenance Staff Training Plan; G

End-User Training Plan; G

1.5 QUALITY ASSURANCE

Data, drawings, and reports must employ the terminology, classifications and methods prescribed by the IES Lighting Library as applicable, for the lighting system specified.

1.5.1 Drawing Requirements

1.5.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), weight, accessories, and installation and construction details. Photometric data, including CRI, CCT, TM-15-11 BUG rating, LED driver type, zonal lumen data, and candlepower distribution data per LM-79 must accompany shop drawings.

1.5.1.2 Pole Drawings

Include dimensions, wind load determined in accordance with ASCE 7-16, pole deflection, pole class, and other applicable information.

1.5.2 Luminaire Design Data

- a. Provide distribution data according to IES classification type as defined in IES 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 DELIVERY, STORAGE, AND HANDLING OF POLES

1.6.1 Aluminum Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.6.2 Steel Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.7 WARRANTY

Support all equipment items by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7.1 Luminaire Warranty

Provide and transfer to the government the original LED luminaire manufacturers standard commercial warranty for each different luminaire manufacturer used in the project.

- a. Provide a written five year minimum replacement warranty for material, luminaire finish, and workmanship. Provide written warranty document that contains all warranty processing information needed, including customer service point of contact, whether or not a return authorization number is required, return shipping information, and closest return location to the luminaire location.

- (1) Finish warranty must include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.

- (2) Material warranty must include:

- (a) All LED drivers and integral control equipment.

- (b) Replacement when more than 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.

1.7.2 Pole Warranty

Provide and transfer to the government the original pole manufacturers standard commercial warranty for each different pole manufacturer used in the project. Warranty coverage must begin from date of final system commissioning or three months from date of delivery, whichever is the earliest. Provide a written three year minimum replacement warranty for material, luminaire finish, and workmanship. Warranty service must be performed by a factory-trained engineer or technician.

1.8 OPERATION AND MAINTENANCE MANUALS

1.8.1 Lighting System

Provide operation and maintenance manuals for the lighting system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the lighting system. Additional O&M Manual requirements for the Army are provided in Section 01 78 24.00 10 FACILITY DATA REQUIREMENTS. Include the following:

- a. Manufacturers' operating and maintenance manuals.
- b. Luminaire shop drawings for modified and custom luminaires.
- c. Luminaire Manufacturers' standard commercial warranty information as specified in paragraph LUMINAIRE WARRANTY.

1.8.2 Exterior Lighting Control System

Provide operation and maintenance manuals for the exterior lighting control system in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA that provide basic data relating to the design, operation, and maintenance of the exterior lighting control system.

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
Accent (adjustable landscape, sign lighting)	35 LPW
Linear Accent (facade, wallwash)	80 LPW
Exterior Wall Sconce	50 LPW
Steplight	30 LPW
Parking Garage Luminaire	113 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
Area and Roadway	All	B3-U0-G3
Pedestrian Post-Top	All	B2-U1-G1

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

- 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 frosted tempered glass or UV-resistant acrylic.
- n. All factory electrical connections are made using crimp, locking, or latching style connectors. Twist-style wire nuts are not acceptable.
- o. NEMA C136.31. Comply with 3G vibration testing.
- p. Luminaire arm bolts constructed from 304 stainless steel or zinc-plated steel.
- q. Wiring compartment on pole-mounted, street and area luminaires is accessible without the use of hand tools to manipulate small screws, bolts, or hardware.
- r. Incorporate modular electrical connections, and construct luminaires to allow replacement of all or any part of the optics, heat sinks, LED drivers, surge suppressors and other electrical components using only a simple tool, such as a manual or cordless electric screwdriver.
- s. ANSI C136.3. For all roadway and area luminaires, provide products with an integral tilt adjustment of plus or minus 5 degrees to allow the unit to be leveled.

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 3000 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 in accordance with the requirements of Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS.

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.

2.5.1.1 Relay Panel

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 relay panel that meets the following criteria:

- a. Input voltage of 120-277 at 50/60 Hz, with internal low voltage power supply as required.
- b. UL 924. 8 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 8 relays.

2.5.2 Devices

2.5.2.1 Photosensors

UL 773, UL 773A. Provide Photosensors that meet the following requirements:

- a. Hermetically sealed, silicon diode light sensor type, rated at 120-277 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.

2.6 POLES

ASCE 7-16. Provide round straight poles designed for wind loading of 100 miles per hour while supporting luminaires and all other appurtenances indicated. The effective projected areas (EPA) of luminaires and appurtenances used in calculations must be specific for the actual products provided on each pole. Provide poles that are anchor-base type designed for use with underground supply conductors. Poles must have oval-shaped hand hole having a minimum clear opening of 3 by 5 inches. Secure hand hole covers by stainless steel captive screws. Provide metal poles with an internal grounding connection accessible from the hand hole near the bottom of each pole. Install a means of wire disconnection accessible from the hand hole. Do not install square poles. Provide poles from a Manufacturer with a standard provision for protecting the finish during shipment and installation. Do not install scratched, stained, chipped, or dented poles.

2.6.1 Aluminum Poles

Provide aluminum poles with uniform satin finish unless otherwise noted in luminaire schedule on project plans. Do not paint aluminum poles. Provide poles that meet the following requirements:

- a. AASHTO LTS. Manufactured of corrosion resistant aluminum alloys for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys.
- b. Seamless extruded or spun seamless-type with minimum 0.188 inch wall thickness.
- c. Top of shaft is fitted with a round or tapered cover.
- d. ASTM B108/B108M. Pole base is mounted by anchor bolts, made of cast 356-T6 aluminum alloy. Base must be machined to receive the lower end of shaft.
- e. Joint between shaft and base is welded.
- f. ASTM B108/B108M. Base cover is cast 356-T6 aluminum alloy.
- g. All hardware other than anchor bolts are either 2024-T4 anodized aluminum alloy or stainless steel.
- h. Grounding connection is designed to prevent electrolysis when used with copper ground wire.

2.6.2 Steel Poles

Provide steel poles with hot-dipped galvanized in accordance with ASTM A123/A123M factory finish. Provide poles that meet the following requirements:

- a. Minimum 11-gage steel with minimum yield/strength of 48,000 psi
- b. Pole is mounted by anchor bolts.
- c. Consists of tapered tubular members, either round in cross section or polygonal.

- d. Pole shaft is one piece and is of welded construction with no bolts, rivets, or other means of fastening except as specifically approved.
- e. Base covers are of structural quality hot-rolled carbon steel plate, with a minimum yield of 36,000 psi.
- f. Markings are approximately 3 to 4 feet above grade and includes manufacturer, year of manufacture, top and bottom diameters, and length.
- g. Grounding connection is designed to prevent electrolysis when used with copper ground wire.

2.6.3 Brackets and Supports

ANSI C136.3, ANSI C136.13, and ANSI C136.21. Provide pole brackets that are not less than 1 1/4 inch galvanized steel pipe or aluminum to match pole material and finish secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets must be coordinated to luminaires provided, and brackets for use with one type of luminaire must be identical. Brackets for pole-mounted street lights must correctly position luminaire no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Provide special mountings or brackets as indicated and of metal which will not promote galvanic reaction with luminaire head.

2.6.4 Pole Foundations

Provide anchor bolts consisting of a steel rod with a minimum yield strength of 50,000 psi; the top 12 inches of the rod must be galvanized in accordance with ASTM A153/A153M. Concrete must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.7 EQUIPMENT IDENTIFICATION

2.7.1 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.

2.7.2 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.

2.8 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 Aluminum and Steel Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit bells, and ground rods must be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE and Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminaire location. Install according to pole manufacturer's instructions. Alterations to poles after fabrication will void manufacturer's warranty and is not allowed.

3.1.5 Lighting Controls

Refer to Section 25 05 11.23 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS for additional lighting control installation requirements.

3.1.5.1 Photosensors

Aim photosensor according to manufacturer's recommendations. Mount sensor on or beside each luminaire when switch is provided in cast weatherproof aluminum housing with swivel arm.

3.1.5.2 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.

3.1.6 Grounding

Ground noncurrent-carrying parts of equipment including metal poles, luminaires, mounting arms, brackets, and metallic enclosures as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.2 FIELD QUALITY CONTROL

3.2.1 Tests

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Perform initial operational test, consisting of the entire system energized for 72 consecutive hours without any failures of any kind occurring in the system. All circuits must test clear of faults, grounds, and open circuits.

3.2.1.1 Lighting Control Verification Test

Verify lighting control system and devices operate according to approved sequence of operations. Verification tests are to be completed after commissioning.

3.3 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.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 27 - COMMUNICATIONS

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM

08/11

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
 - 1.3.1 Campus Distributor (CD)
 - 1.3.2 Building Distributor (BD)
 - 1.3.3 Floor Distributor (FD)
 - 1.3.4 Telecommunications Room (TR)
 - 1.3.5 Entrance Facility (EF) (Telecommunications)
 - 1.3.6 Equipment Room (ER) (Telecommunications)
 - 1.3.7 Open Cable
 - 1.3.8 Open Office
 - 1.3.9 Pathway
- 1.4 SYSTEM DESCRIPTION
- 1.5 SUBMITTALS
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Shop Drawings
 - 1.6.1.1 Telecommunications Drawings
 - 1.6.1.2 Telecommunications Space Drawings
 - 1.6.2 Telecommunications Qualifications
 - 1.6.2.1 Telecommunications Contractor
 - 1.6.2.2 Key Personnel
 - 1.6.2.3 Minimum Manufacturer Qualifications
 - 1.6.3 Test Plan
 - 1.6.4 Regulatory Requirements
 - 1.6.5 Standard Products
 - 1.6.5.1 Alternative Qualifications
 - 1.6.5.2 Material and Equipment Manufacturing Date
- 1.7 DELIVERY AND STORAGE
- 1.8 ENVIRONMENTAL REQUIREMENTS
- 1.9 WARRANTY
- 1.10 MAINTENANCE
 - 1.10.1 Operation and Maintenance Manuals
 - 1.10.2 Record Documentation
 - 1.10.3 Spare Parts

PART 2 PRODUCTS

- 2.1 COMPONENTS
- 2.2 TELECOMMUNICATIONS PATHWAY
- 2.3 TELECOMMUNICATIONS CABLING
 - 2.3.1 Backbone Cabling
 - 2.3.1.1 Backbone Copper
 - 2.3.1.2 Backbone Optical Fiber
 - 2.3.2 Horizontal Cabling

- 2.4 TELECOMMUNICATIONS SPACES
 - 2.4.1 Backboards
 - 2.4.2 Equipment Support Frame
 - 2.4.3 Connector Blocks
 - 2.4.4 Cable Guides
 - 2.4.5 Patch Panels
 - 2.4.5.1 Fiber Optic Patch Panel
 - 2.4.6 Optical Fiber Distribution Panel
- 2.5 TELECOMMUNICATIONS OUTLET/CONNECTOR ASSEMBLIES
 - 2.5.1 Outlet/Connector Copper
 - 2.5.2 Optical Fiber Adapters(Couplers)
 - 2.5.3 Optical Fiber Connectors
 - 2.5.4 Cover Plates
- 2.6 GROUNDING AND BONDING PRODUCTS
- 2.7 FIRESTOPPING MATERIAL
- 2.8 MANUFACTURER'S NAMEPLATE
- 2.9 FIELD FABRICATED NAMEPLATES
- 2.10 TESTS, INSPECTIONS, AND VERIFICATIONS
 - 2.10.1 Factory Reel Tests
- 2.11 SATELLITE TELEVISION

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Cabling
 - 3.1.1.1 Open Cable
 - 3.1.1.2 Backbone Cable
 - 3.1.2 Pathway Installations
 - 3.1.3 Service Entrance Conduit, Underground
 - 3.1.4 Cable Tray Installation
 - 3.1.5 Work Area Outlets
 - 3.1.5.1 Pull Cords
 - 3.1.6 Telecommunications Space Termination
 - 3.1.6.1 Connector Blocks
 - 3.1.6.2 Patch Panels
 - 3.1.6.3 Equipment Support Frames
 - 3.1.7 Electrical Penetrations
 - 3.1.8 Grounding and Bonding
- 3.2 LABELING
 - 3.2.1 Labels
 - 3.2.2 Cable
- 3.3 FIELD APPLIED PAINTING
 - 3.3.1 Painting Backboards
- 3.4 FIELD FABRICATED NAMEPLATE MOUNTING
- 3.5 TESTING
 - 3.5.1 Telecommunications Cabling Testing
 - 3.5.1.1 Inspection
 - 3.5.1.2 Verification Tests
 - 3.5.1.3 Performance Tests

-- End of Section Table of Contents --

SECTION 27 10 00

BUILDING TELECOMMUNICATIONS CABLING SYSTEM
08/11

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D709 (2017) Standard Specification for
Laminated Thermosetting Materials

ELECTRONIC COMPONENTS INDUSTRY ASSOCIATION (ECIA)

ECIA EIA/ECA 310-E (2005) Cabinets, Racks, Panels, and
Associated Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative
Dictionary of IEEE Standards Terms

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-83-596 (2016) Indoor Optical Fiber Cables

ICEA S-90-661 (2012) Category 3, 5, & 5e Individually
Unshielded Twisted Pair Indoor Cables for
Use in General Purpose and LAN
Communications Wiring Systems Technical
Requirements

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA/BICSI 568 (2006) Standard for Installing Building
Telecommunications Cabling

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2
2020; TIA 20-1; TIA 20-2; TIA
20-3; TIA 20-4) National
Electrical Code

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-1152 (2009) Requirements for Field Test
Instruments and Measurements for Balanced
Twisted-Pair Cabling

TIA-455-21 (1988a; R 2012) FOTP-21 - Mating

	Durability of Fiber Optic Interconnecting Devices
TIA-526-7	(2015a) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
TIA-568.0-E	((2020e)) Generic Telecommunications Cabling for Customer Premises
TIA-568.1-E	(2020e) Commercial Building Telecommunications Cabling Standard
TIA-568.4-E	(July 2022) Broadband Coaxial Cabling and Components Standard
TIA-568.2-D	(2018d) ADDENDUM 2 2020) Balanced Twisted-Pair Telecommunications Cabling and Components Standards
TIA-568.3-D	(2016d ADDENDUM 1 2022e) Optical Fiber Cabling Components Standard
TIA-569	(2019e) ADDENDUM 1 2019) Commercial Building Standard for Telecommunications Pathways and Spaces
TIA-606	(2021d) Administration Standard for the Telecommunications Infrastructure
TIA-607	((2019d) ADDENDUM 1 2021) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
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

UNDERWRITERS LABORATORIES (UL)

UL 1286	(2008; Reprint Apr 2021) UL Standard for Safety Office Furnishings
UL 1666	(2007; Reprint Jun 2012) Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
UL 444	(2008; Reprint Apr 2015) Communications Cables
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment,

Non-Environmental Considerations

- 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

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and Section 33 82 00 TELECOMMUNICATIONS, OUTSIDE PLANT (OSP), apply to this section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification shall be as defined in TIA-568.1-E, TIA-568.2-D, TIA-568.3-D, TIA-569, TIA-606 and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect (MC).)

1.3.2 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect (IC).)

1.3.3 Floor Distributor (FD)

A distributor used to connect horizontal cable and cabling subsystems or equipment. (International expression for horizontal cross-connect (HC).)

1.3.4 Telecommunications Room (TR)

An enclosed space for housing telecommunications equipment, cable, terminations, and cross-connects. The room is the recognized cross-connect between the backbone cable and the horizontal cabling.

1.3.5 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including wireless) including the entrance point at the building wall and continuing to the equipment room.

1.3.6 Equipment Room (ER) (Telecommunications)

An environmentally controlled centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.7 Open Cable

Cabling that is not run in a raceway as defined by NFPA 70. This refers

to cabling that is "open" to the space in which the cable has been installed and is therefore exposed to the environmental conditions associated with that space.

1.3.8 Open Office

A floor space division provided by furniture, moveable partitions, or other means instead of by building walls.

1.3.9 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The building telecommunications cabling and pathway system shall include permanently installed backbone, 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 backbone cabling and pathway system includes intrabuilding and interbuilding interconnecting cabling, pathway, and terminal hardware. The intrabuilding backbone provides connectivity from the floor distributors to the building distributors or to the campus distributor and from the building distributors to the campus distributor as required. The backbone system shall be wired in a star topology with the campus distributor at the center or hub of the star. The interbuilding backbone system provides connectivity between the campus distributors and is specified in Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP). Provide telecommunications pathway systems referenced herein as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. The telecommunications contractor must coordinate with the NMCI/COSC/NGEN contractor concerning access to and configuration of telecommunications spaces. The telecommunications contractor may be required to coordinate work effort within the telecommunications spaces with the NMCI/COSC/NGEN contractor.

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. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telecommunications drawings; G

Telecommunications Space Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Telecommunications cabling (backbone and horizontal); G

Patch panels; G

Telecommunications outlet/connector assemblies; G

Equipment support frame; G

Connector blocks; G

Spare Parts; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Include performance and characteristic curves. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Telecommunications cabling testing; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Manufacturer Qualifications; G

Test plan; G

SD-09 Manufacturer's Field Reports

Factory reel tests; G

SD-10 Operation and Maintenance Data

Telecommunications cabling and pathway system Data Package 5; G

SD-11 Closeout Submittals

Record Documentation; G

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

In exception to Section 01 33 00 SUBMITTAL PROCEDURES, submitted plan drawings shall be a minimum of 11 by 17 inches in size using a minimum scale of 1/8 inch per foot, 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. 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 - Firestopping, Americans with Disabilities Act (ADA), Safety, Department of Transportation (DOT). Detailed drawings of symbols and typicals such as faceplate types, 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 and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, and the supervisor (if different from the installer). A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems within the past 3 years of similar scope and size. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor.

1.6.2.2 Key Personnel

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Supervisors and installers assigned to the installation of this system or any of its components shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level. Submit documentation of current BICSI certification for each of the key personnel.

In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components. They shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications systems and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project

description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568.1-E, TIA-568.2-D and TIA-568.3-D.

1.6.3 Test Plan

Provide a complete and detailed test plan for the telecommunications cabling system including a complete list of test equipment for the components and accessories for each cable type specified, 60 days prior to the proposed test date. Include procedures for certification, validation, and testing.

1.6.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 1 year prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 DELIVERY AND STORAGE

Provide protection from weather, moisture, extreme heat and cold, dirt, dust, and other contaminants for telecommunications cabling and equipment placed in storage.

1.8 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 32 to 140 degrees F and in the range of 0 to 95 percent relative humidity, noncondensing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.10 MAINTENANCE

1.10.1 Operation and Maintenance Manuals

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications cabling and pathway system, Data Package 5. Submit operations and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data Package 5, include the requirements of paragraphs TELECOMMUNICATIONS DRAWINGS, TELECOMMUNICATIONS SPACE DRAWINGS, and RECORD DOCUMENTATION. Ensure that these drawings and documents depict the as-built configuration.

1.10.2 Record Documentation

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts, 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 the required data

fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with TIA-606. Include manufacture date of cable with submittal.

- b. Termination Hardware - A record of installed patch panels, cross-connect points, distribution frames, terminating block arrangements and type shall be provided in accordance with TIA-606. Documentation shall include the required data fields only 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-E, TIA-568.1-E, TIA-568.2-D, TIA-568.3-D, TIA-568.4-E 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 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 Copper

Copper backbone cable shall be solid conductor, 24 AWG, 100 ohm, 50-pair, Category 5e, UTP, in accordance with ICEA S-90-661, TIA-568.1-E, TIA-568.2-D, TIA-568.4-E and UL 444, formed into 25 pair binder groups covered with a gray thermoplastic jacket and overall metallic shield. Cable shall be imprinted with manufacturers name or identifier, flammability rating, gauge of conductor, transmission performance rating (category designation) at regular length marking 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.

2.3.1.2 Backbone Optical Fiber

Provide in accordance with ICEA S-83-596, TIA-568.3-D, UL 1666 and NFPA 70. Cable shall be imprinted with fiber count, fiber type and aggregate length at regular intervals not to exceed 40 inches.

Provide the number of strands indicated, (but not less than 12 strands between the main telecommunication room and each of the other telecommunication rooms), of single-mode(OS1), tight buffered fiber optic cable.

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

Horizontal cabling for copper is not in this package. To be provided and installed by others.

2.4 TELECOMMUNICATIONS SPACES

Provide connecting hardware and termination equipment in the telecommunications entrance facility and telecommunication equipment rooms to facilitate installation as shown on design drawings for terminating and cross-connecting permanent cabling. Provide telecommunications interconnecting hardware color coding in accordance with TIA-606.

2.4.1 Backboards

Provide void-free, interior grade A-C plywood 3/4 inch thick 4 by 8 feet as indicated. Backboards shall be fire rated by manufacturing process. Fire stamp shall be clearly visible. 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. 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 cabinet with grounding bar roof mounted filter and a surge protected power strip with 6 duplex 20 amp receptacles.

All cabinets shall be keyed alike.

2.4.3 Connector Blocks

Provide insulation displacement connector (IDC) Type 110 for Category 6 systems. Provide blocks for the number of horizontal and backbone cables terminated on the block plus 25 percent spare.

2.4.4 Cable Guides

Provide cable guides specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 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, 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 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-D. Patch cords shall meet minimum performance requirements specified in TIA-568.1-E, TIA-568.2-D and TIA-568.3-D for cables, cable length and hardware specified.

2.4.5.1 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 single-mode adapters as duplex LC in accordance with TIA/EIA-604-10 with zirconia ceramic alignment sleeves, 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 single-mode pigtails and adapters. Provide adapters as duplex LC with zirconia ceramic alignment sleeves. 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/connector copper is not in this package. It's to be provided and installed by others.

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, as indicated. 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, 8/125 single-mode fiber. The connectors shall provide a maximum attenuation of 0.3 dB at 1310 and 1550 nm with less than a 0.2 dB change after 500 mating cycles.

2.5.4 Cover Plates

Cover plates are not in this package. They're to be provided and installed by others.

2.6 GROUNDING AND BONDING PRODUCTS

Provide in accordance with UL 467, TIA-607, and NFPA 70. Components shall be identified as required by TIA-606. Provide ground rods, bonding conductors, and grounding busbars as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.7 FIRESTOPPING MATERIAL

Provide as specified in Section 07 84 00 FIRESTOPPING.

2.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.9 FIELD FABRICATED NAMEPLATES

ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inches thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inches high normal block style.

2.10 TESTS, INSPECTIONS, AND VERIFICATIONS

2.10.1 Factory Reel Tests

Provide documentation of the testing and verification actions taken by manufacturer to confirm compliance with TIA-568.1-E, TIA-568.2-D, TIA-568.3-D, and TIA-526-7 for single mode optical fiber cables.

2.11 SATELLITE TELEVISION

Satellite TV service is provided by Don-Lors Electronics. The contractor will provide pathways and horizontal cable to support the satellite and head-end equipment in accordance with TIA-568.4-E. (both provided by Don-Lors).

The contractor will reserve 3-feet by 3-feet in both Unclassified DRs for satellite TV head-end equipment.

The contractor will provide pathways from both communications rooms to the roof penetration and sealed weather-heads. The satellite will point to the southern sky and require clear line-of-sight at an angle of 30 to 40, with no obstructions to three different satellites. For this reason, the penetration will be on the south side of the roof top.

The contractor will provide two sets of (3) RG-11 cables from the satellite to each communications room head-end location on the first and second floor. These backbone cables will be dedicated runs with no splitters and provide service from both orbits (3 cables each orbit). The contractor will weatherize coax connections on the roof top and bond all cable and hardware for these six coax cables.

Both sides of the (6) RG-11 coax cables will be terminated into bonded lightning arrestor banks rated for the signal of the RG-11. These will be both bonded and weatherized on the top of the building.

The contractor will provide a wall-mount RG-11 termination field, loaded with modules at each 3-feet by 3-feet reserved area. These RG-11 coax termination fields will terminate all horizontal RG-11 cables leading to individual TV service ports in the building.

The contractor will provide horizontal RG-11 coax rated at 3Ghz from the head-end termination field to each F-connector faceplate. Cables will be dedicated, less than 200 feet, and without splitters. In the event any cable exceeds 200 feet, the contractor will notify Don-Lors. For these exceptions (not anticipated) Don-Lors must provide a SmartBox location and the head-end equipment area to boost the signal.

The contractor will terminate all RG-11 with F-connectors rated for 3Ghz

or better.

From the head-end location in each DR to individual workstations, the contractor will provide RG-11 cable that is rated at 3Ghz.

PART 3 EXECUTION

3.1 INSTALLATION

Install telecommunications cabling and pathway systems, including the horizontal and backbone cable, pathway systems, telecommunications outlet/connector assemblies, and associated hardware in accordance with NECA/BICSI 568, TIA-568.1-E, TIA-568.2-D, TIA-568.3-D, TIA-569, NFPA 70, and UL standards as applicable. Provide cabling in a star topology network. Pathways and outlet boxes shall be installed as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Install telecommunications cabling with copper media in accordance with the following criteria to avoid potential electromagnetic interference between power and telecommunications equipment. The interference ceiling shall not exceed 3.0 volts per meter measured over the usable bandwidth of the telecommunications cabling. Cabling shall be run with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

3.1.1 Cabling

Install coaxial and optical fiber telecommunications cabling system as detailed in TIA-568.1-E, TIA-568.2-D, and TIA-568.3-D. Screw terminals shall not be used except where specifically indicated on plans. Use an approved insulation displacement connection (IDC) tool kit for copper cable terminations. Do not exceed manufacturers' cable pull tensions for copper and optical fiber cables. Provide a device to monitor cable pull tensions. Do not exceed 25 pounds pull tension for four pair copper cables. Do not chafe or damage outer jacket materials. Use only lubricants approved by cable manufacturer. Do not over cinch cables, or crush cables with staples. For UTP cable, bend radii shall not be less than four times the cable diameter. Cables shall be terminated; no cable shall contain unterminated elements. Cables shall not be spliced. Label cabling in accordance with paragraph LABELING in this section.

3.1.1.1 Open Cable

Use only where specifically indicated on plans for use in cable trays. Install in accordance with TIA-568.1-E, TIA-568.2-D and TIA-568.3-D. 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.

3.1.1.2 Backbone Cable

- a. Copper Backbone Cable. Install intrabuilding backbone copper cable, in indicated pathways, between the campus distributor, located in the telecommunications entrance facility or room, the building distributors and the floor distributors located in telecommunications rooms and telecommunications equipment rooms as indicated on drawings.

- b. 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.

3.1.2 Pathway Installations

Provide in accordance with TIA-569 and NFPA 70. Provide building pathway as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.3 Service Entrance Conduit, Underground

Provide service entrance underground as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.4 Cable Tray Installation

Install cable tray as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Only CMP and OFNP type cable shall be installed in a plenum.

3.1.5 Work Area Outlets

3.1.5.1 Pull Cords

Pull cords shall be installed in conduit serving telecommunications outlets that do not have cable installed.

3.1.6 Telecommunications Space Termination

Install termination hardware required for optical fiber system. An insulation displacement tool shall be used for terminating copper cable to insulation displacement connectors.

3.1.6.1 Connector Blocks

Connector blocks shall be wall mounted in orderly rows and columns. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Install in accordance with industry standard wire routing guides in accordance with TIA-569.

3.1.6.2 Patch Panels

Patch panels shall be mounted in equipment cabinets with sufficient ports to accommodate the installed cable plant plus 25 percent spares.

- a. Fiber Optic Patch Panel. Fiber optic cable loop shall be 3 feet in length. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.6.3 Equipment Support Frames

Install in accordance with TIA-569:

- a. Bracket, wall mounted. Mount bracket to plywood backboard in accordance with manufacturer's recommendations. Mount rack so height of highest panel does not exceed 78 inches above floor.
- b. 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.

3.1.7 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings as specified in Section 07 84 00 FIRESTOPPING.

3.1.8 Grounding and Bonding

Provide in accordance with TIA-607, NFPA 70 and as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.2 LABELING

3.2.1 Labels

Provide labeling in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for voice and data circuits shall be provided using thermal ink transfer process.

3.2.2 Cable

Cables shall be labeled using color labels on both ends with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.3.1 Painting Backboards

If backboards are required to be painted, then the manufactured fire retardant backboard must be painted with fire retardant paint, so as not to increase flame spread and smoke density and must be appropriately labeled. Label and fire rating stamp must be unpainted.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 TESTING

3.5.1 Telecommunications Cabling Testing

Perform telecommunications cabling inspection, verification, and performance tests in accordance with TIA-568.1-E, TIA-568.2-D, TIA-568.3-D.

Test equipment shall conform to TIA-1152. Perform optical fiber field inspection tests via attenuation measurements on factory reels and provide

results along with manufacturer certification for factory reel tests.
Remove failed cable reels from project site upon attenuation test failure.

3.5.1.1 Inspection

Visually inspect UTP and optical fiber jacket materials for UL or third party certification markings. Inspect cabling terminations in telecommunications rooms and at workstations to confirm color code for T568A or T568B pin assignments, and inspect cabling connections to confirm compliance with TIA-568.1-E, TIA-568.2-D, TIA-568.3-D.

3.5.1.2 Verification Tests

UTP backbone copper cabling shall be tested for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors, and between conductors and shield, if cable has overall shield. Test operation of shorting bars in connection blocks. Test cables after termination but prior to being cross-connected.

For single-mode optical fiber, perform optical fiber end-to-end attenuation tests in accordance with TIA-568.3-D and TIA-526-7 using Method B, OTDR for single-mode optical fiber. Perform verification acceptance tests.

3.5.1.3 Performance Tests

- a. Optical fiber Links. Perform optical fiber end-to-end link tests in accordance with TIA-568.3-D.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

SECTION 28 08 10

ELECTRONIC SECURITY SYSTEM ACCEPTANCE TESTING

05/16

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 DEFINITIONS
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Qualifications
 - 1.4.1.1 General
 - 1.4.1.2 Test Director
 - 1.4.1.3 Operator
 - 1.4.1.4 Technician
 - 1.4.1.5 Test Intruder

PART 2 PRODUCTS

PART 3 EXECUTION

- 3.1 TEST PLAN
 - 3.1.1 Personnel
 - 3.1.2 Equipment
 - 3.1.3 Procedures
 - 3.1.4 Special Provisions
 - 3.1.5 Test Logs
 - 3.1.6 Schedule
- 3.2 PRE-ACCEPTANCE TESTING
 - 3.2.1 Phased Testing
 - 3.2.1.1 Functional Testing Phase
 - 3.2.1.2 Burn-In Testing Phase
 - 3.2.2 Draft Test Report
- 3.3 SYSTEM ACCEPTANCE
 - 3.3.1 Preparation
 - 3.3.2 Personnel
 - 3.3.3 Visual Inspection
 - 3.3.4 Functional Testing
 - 3.3.5 System Activity Reports
 - 3.3.6 Corrective Actions
- 3.4 FINAL TEST REPORT
 - 3.4.1 Summary
 - 3.4.2 Personnel
 - 3.4.3 Test Logs

-- End of Section Table of Contents --

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 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-05 Design Data

Test Plan; G

SD-06 Test Reports

Draft Test Report

Final Test Report; G

SD-07 Certificates

Qualifications

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 General

The Test Director, Operator, and Technician must have prior experience with the specific equipment, hardware and software installed under the contract.

1.4.1.2 Test Director

The Test Director must have at least five years of hands-on ESS experience to include any combination of design, installation, testing and maintenance.

1.4.1.3 Operator

The Operator must have at least two years of hands-on experience installing and maintaining ESS workstations to include both hardware and software. The Operator must be capable of demonstrating all workstation features and capabilities.

1.4.1.4 Technician

The technician must have at least two years of hands-on experience installing and maintaining ESS field equipment to include sensors, card readers, cameras, local processors, and communications equipment. The Technician must be capable of demonstrating all features and capabilities of ESS field equipment. Qualifications may be met by the individual experience of one technician or by the combined experience of a team of technicians.

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 120-hour period. During this time, the ESS must be fully functional and programmed such that all features can be exercised and evaluated through normal use. Record all system anomalies in approved Test Logs. Include a description of each anomaly along with any actions taken in response. Immediately correct minor deficiencies observed during the course of testing and

continue with burn-in testing. Determine the root cause of any failures and make necessary repairs or modifications to restore full functionality. After a failure is corrected repeat functional tests for components and features associated with the failure, and repeat the entire burn-in testing phase .

3.2.2 Draft Test Report

Prepare and submit a Draft Test Report detailing the results of the testing. Refer to paragraph FINAL TEST REPORT for required content. Include a cover letter signed by the Test Director stating that pre-acceptance testing has been completed and that the system is ready for acceptance testing.

3.3 SYSTEM ACCEPTANCE

Test the ESS in accordance with the approved Test Plan in the presence of the Government Representative to certify acceptable performance. Verify that the total system meets all requirements of the specification and complies with the specified standards.

Begin acceptance testing upon arrival of the Government Representative at the project site. Place the ESS in normal operating mode and evaluate system performance during the testing period. Immediately report any deficiencies observed during testing to the Government Representative and discuss possible causes and corrective measures. Obtain Government approval prior to making any adjustments, repairs or modifications. The Government retains the right to terminate testing at any time the ESS is found to be incomplete or fails to perform as specified. Such termination of acceptance testing constitutes a FAILED system acceptance test.

3.3.1 Preparation

Notify the Contracting Officer of system readiness 15 days prior to the expected start date of acceptance testing. Prior to acceptance testing, complete all clean-up and patch work requirements. Ensure that security equipment closets and similar areas are free of accumulation of waste materials or rubbish caused by prior installation work.

3.3.2 Personnel

Ensure that the following personnel are on site to perform test activities: Test Director, Operator, Technician, 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.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

SECTION 28 10 05

ELECTRONIC SECURITY SYSTEMS (ESS)

05/16

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY ASSURANCE
 - 1.3.1 Regulatory Requirements
 - 1.3.2 Standard Products
 - 1.3.2.1 Alternative Qualifications
 - 1.3.2.2 Material and Equipment Manufacturing Date
 - 1.3.2.3 Product Safety
 - 1.3.3 Shop Drawings
 - 1.3.3.1 ESS Components
 - 1.3.3.2 Overall System Schematic
 - 1.3.4 Evidence of Experience and Qualifications
 - 1.3.4.1 Contractor Qualifications
 - 1.3.4.2 Instructor Qualifications
- 1.4 Environmental Conditions
 - 1.4.1 Interior Conditions
 - 1.4.1.1 Temperature
 - 1.4.1.2 Pressure
 - 1.4.1.3 Relative Humidity
 - 1.4.1.4 Fungus
 - 1.4.1.5 Acoustical Noise
 - 1.4.2 Exterior Conditions
 - 1.4.2.1 Temperature
 - 1.4.2.2 Pressure
 - 1.4.2.3 Solar Radiation
 - 1.4.2.4 Sand and Dust
 - 1.4.2.5 Rain
 - 1.4.2.6 Humidity
 - 1.4.2.7 Fungus
 - 1.4.2.8 Salt Fog
 - 1.4.2.9 Snow
 - 1.4.2.10 Ice Accretion
 - 1.4.2.11 Wind
 - 1.4.2.12 Acoustical Noise
- 1.5 SYSTEM CALCULATIONS AND ANALYSIS
 - 1.5.1 Backup Battery Capacity Calculations
 - 1.5.2 CCTV Storage Calculations
- 1.6 ESS SOFTWARE, DATA PACKAGE 4
- 1.7 AS-BUILT DRAWINGS

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
- 2.2 PERFORMANCE REQUIREMENTS

- 2.2.1 Growth Capability
- 2.2.2 Hazardous Locations
- 2.2.3 Network Certification
- 2.2.4 Maintainability
- 2.2.5 Availability
- 2.2.6 Line Supervision
- 2.2.7 Power Loss Detection
- 2.2.8 Controls and Designations
- 2.2.9 Special Test Equipment
- 2.3 INTRUSION DETECTION SYSTEM (IDS)
 - 2.3.1 IDS Components
 - 2.3.2 Detection Sensitivity
 - 2.3.3 Detection Alarm and Reporting Capacity
 - 2.3.4 False Alarm Rate
 - 2.3.5 Nuisance Alarm Rate
 - 2.3.6 Premise Control Unit (PCU)
 - 2.3.6.1 PCU Capabilities
 - 2.3.6.2 Overcurrent Protection and Indication
 - 2.3.6.3 Manual and Self-Test
 - 2.3.7 Detection Sensors
 - 2.3.7.1 Interior Sensors
 - 2.3.7.1.1 High Security Balanced Magnetic Switch (BMS)
 - 2.3.7.1.1.1 Level 1 Switch
 - 2.3.7.1.1.2 Level 2 Switch
 - 2.3.7.1.2 Glass Break Detection
 - 2.3.7.1.3 Passive Infrared Sensors
 - 2.3.7.1.4 Dual Technology Sensors
 - 2.3.7.2 Tamper Switches
 - 2.3.7.2.1 Tamper Switch Performance Requirements
- 2.4 ACCESS CONTROL SYSTEM (ACS)
 - 2.4.1 ACS Programming
 - 2.4.1.1 Time Schedules
 - 2.4.1.2 Special Days
 - 2.4.1.3 ACU Daylight Savings Time Adjustment
 - 2.4.1.4 Scheduled Events
 - 2.4.1.5 Maximum User Capability
 - 2.4.1.6 Access Groups
 - 2.4.1.7 Active and Expire Dates
 - 2.4.1.8 Maximum Use Settings
 - 2.4.1.9 Door Outputs
 - 2.4.1.10 Anti-Passback
 - 2.4.1.11 Two Person Rule
 - 2.4.1.12 User List or Who's In (Muster Reports)
 - 2.4.1.13 Crisis Mode
 - 2.4.1.14 Door Groups
 - 2.4.1.15 Door Interlocking
 - 2.4.1.16 PIN Required
 - 2.4.1.17 Remote Door Control
 - 2.4.1.18 Key Control
 - 2.4.1.19 Guard Tour
 - 2.4.1.20 Reader Disable
 - 2.4.1.21 Disable Event Messages
 - 2.4.1.22 Input and Output Groups
 - 2.4.1.23 Delays
 - 2.4.1.24 Remote Input Control
 - 2.4.1.25 Output Configuration
 - 2.4.1.26 Remote Output Control
 - 2.4.1.27 Remote Reset Command
 - 2.4.1.28 Time Zone

- 2.4.1.29 User-Selected LED Behavior
- 2.4.1.30 Traced Cards
- 2.4.1.31 Badge Print Tracking
- 2.4.2 Error and Throughput Rates
- 2.4.3 Access Control System Central Processing
- 2.4.4 Access Control Unit(ACU)
- 2.4.5 Access Control Devices
 - 2.4.5.1 Card Readers
 - 2.4.5.1.1 Contactless Card Readers
 - 2.4.5.1.2 Card Reader Display
 - 2.4.5.1.3 Card Reader Response Time
 - 2.4.5.1.4 Card Reader Power
 - 2.4.5.1.5 Card Reader Mounting Method
 - 2.4.5.2 Portal Control Devices
 - 2.4.5.2.1 Push-Button Switches
 - 2.4.5.2.2 Panic Bar
 - 2.4.5.2.2.1 Emergency Egress With Alarm
 - 2.4.5.2.2.2 Normal Egress
 - 2.4.5.2.2.3 Delay Egress With Alarm
 - 2.4.5.2.3 Electromagnetic Lock
 - 2.4.5.2.3.1 Armature
 - 2.4.5.2.3.2 Tamper Resistance
 - 2.4.5.2.3.3 Mounting Method
- 2.5 CLOSED-CIRCUIT TELEVISION (CCTV) SYSTEM
 - 2.5.1 Cameras
 - 2.5.1.1 CCTV Camera
 - 2.5.1.1.1 Sensitivity
 - 2.5.1.1.2 Signal-To-Noise Ratio
 - 2.5.1.1.3 Resolution
 - 2.5.1.1.4 Synchronization
 - 2.5.1.1.5 Low Light Level
 - 2.5.1.2 Camera Lenses
 - 2.5.1.3 Camera Housing and Mounts
 - 2.5.1.3.1 Environmentally Sealed Camera Housing
 - 2.5.1.3.2 Indoor Camera Housing
 - 2.5.1.3.3 Interior Mount
 - 2.5.1.3.4 Low Profile Ceiling Mount
- 2.6 SECURITY COMMAND CENTER (SCC)
 - 2.6.1 ESS Software
 - 2.6.1.1 Alarm Call up
 - 2.6.1.2 Programming
 - 2.6.1.2.1 Daylight Savings Time Adjustment
 - 2.6.1.2.2 Operator Privileges
 - 2.6.1.2.3 Alarm Priorities
 - 2.6.1.2.4 Reports
 - 2.6.1.2.5 User Interface
 - 2.6.1.2.6 Messages
 - 2.6.1.2.7 Graphics
 - 2.6.1.2.8 Device Status
 - 2.6.1.2.9 Diagnostics
 - 2.6.1.2.10 Mandatory Data Fields
 - 2.6.1.2.11 User Defined Data Fields
 - 2.6.1.2.12 Archive Database
 - 2.6.1.2.13 Programmable Database Backup
 - 2.6.1.2.14 Programmable Database Purging
 - 2.6.1.2.15 Database Importing
 - 2.6.1.2.16 Data Exporting
 - 2.6.1.2.17 Event Log Output
 - 2.6.1.2.18 Data Audit Trail

- 2.7 COMMUNICATIONS
 - 2.7.1 Hardwire
 - 2.7.1.1 Electrical Conductor Lines
 - 2.7.1.2 Communication Link
 - 2.7.2 Data Encryption
 - 2.7.3 Network Switch
 - 2.7.4 Wire and Cable
 - 2.7.5 Local Area Network (LAN) Cabling
 - 2.7.6 Cable Construction
- 2.8 SURVEILLANCE AND DETECTION EQUIPMENT
 - 2.8.1 Metal Detector
 - 2.8.1.1 Electrical
- 2.9 BACKUP POWER
 - 2.9.1 Uninterruptible Power Supply (UPS)
 - 2.9.2 Batteries
- 2.10 COMPONENT ENCLOSURE
 - 2.10.1 Interior Enclosures
 - 2.10.2 Exposed-to-Weather Enclosures
 - 2.10.3 Corrosion-Resistant Enclosures
 - 2.10.4 Hazardous Environment Equipment
 - 2.10.5 Ventilation
 - 2.10.6 Mounting
 - 2.10.7 Labels
 - 2.10.8 Test Points
- 2.11 LOCKS AND KEY LOCK
 - 2.11.1 Lock
 - 2.11.2 Key-Lock Operated Switches

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Existing Equipment
 - 3.1.2 Software Installation
 - 3.1.3 Cable and Wire Runs
 - 3.1.4 Conduits
- 3.2 ADJUSTMENT, ALIGNMENT, SYNCHRONIZATION, AND CLEANING
- 3.3 SYSTEM STARTUP
- 3.4 SUPPLEMENTAL CONTRACTOR QUALITY CONTROL
- 3.5 ESS SYSTEM TESTING
- 3.6 ESS TRAINING
 - 3.6.1 Maintenance Personnel Training

-- End of Section Table of Contents --

SECTION 28 10 05

ELECTRONIC SECURITY SYSTEMS (ESS)
05/16

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ASC/X9 X9.52 (1998) Triple Data Encryption Algorithm
Modes of Operation

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.23 (2010) Electromagnetic Locks

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3 (2018) Ethernet

IEEE C2 (2017; Errata 1-2 2017; INT 1 2017)
National Electrical Safety Code

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

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

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

OPEN NETWORK VIDEO INTERFACE FORUM (ONVIF)

ONVIF	(2017) Core Specification Version 17.06
-------	---

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. 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 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	(2016) UL Standard for Safety Printed-Wiring Boards
UL 1037	(2016; Reprint Sep 2017) UL Standard for Safety Antitheft Alarms and Devices
UL 1076	(2018; 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 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

ESS Components; G, AE

Overall System Schematic; G, AE

SD-03 Product Data

Premise Control Unit; G

Detection Sensors; G

Access Control Unit; G

Access Control Devices; G

Cameras; G

Camera Lenses; G

Camera Housing and Mounts; G

Network Switch; G

Uninterruptible Power Supply (UPS); G

Batteries; G

Component Enclosure; G

SD-05 Design Data

Backup Battery Capacity Calculations; G, AE

Access Control Throughput Rates; G, AE

CCTV Storage Calculations

SD-07 Certificates

Contractor Qualifications; G

Instructor Qualifications; G

Data Encryption; G

SD-10 Operation and Maintenance Data

ESS Components and ESS Software: Data Package 4; G

ESS Software and ESS Components: Data Package 4; G

Submit data package in accordance with Section 01 78 23
OPERATION AND MAINTENANCE DATA

SD-11 Closeout Submittals

As-Built Drawings; G

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 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.

1.5.2 CCTV Storage Calculations

Submit calculations showing the required storage capacity for each video storage device.

1.6 ESS SOFTWARE, DATA PACKAGE 4

Submit the ESS software, Data Package 4 with the ESS Components submittal package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Describe the functions of all software in the software manual and include:

- a. All information necessary to enable proper loading, testing, and operation
- b. Terms and functions definitions
- c. Use of system and application software
- d. Procedures for system initialization, start-up and shutdown
- e. Alarm reports
- f. Reports generation
- g. Database format and data entry requirements
- h. Directory of all files
- i. All communication protocol descriptions, including data formats, command characters, and a sample of each type of data transfer
- j. Interface definition
- k. List of software keys

1.7 AS-BUILT DRAWINGS

Maintain a separate set of drawings, elementary diagrams, and wiring diagrams of the system to be used for as-built drawings. Keep this set accurately and neatly up-to-date with all changes and additions. This set is not to be used for installation purposes.

Finish the final drawings submitted with the endurance test report.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide a complete and integrated electronic security system (ESS) that the meet requirements of this document. ESS must be compatible with the

Installation's central monitoring system and monitored within the secure/protected area and at the Installation central monitoring station.

- a. Intrusion Detection System (IDS)
- b. Access Control System (ACS)
- c. Closed-circuit Television System (CCTV)
- d. Communications System

Include materials not normally furnished by the manufacturer with the ESS equipment as specified in:

- a. Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION
- b.. Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

2.2 PERFORMANCE REQUIREMENTS

Integrate the installed and operating subsystems into the overall ESS system to detect intrusion, control access, provide CCTV surveillance, provide visual verification, and perform as an entity, as specified below. Provide electronic equipment that complies with 47 CFR 15 and are suitable for the environment where they will be installed.

2.2.1 Growth Capability

Provide capability for modular ESS expansion of inputs, outputs, card readers, and remote control stations with minimal equipment modification. Software must be able to handle design requirements plus 25 percent spare capacity. Growth capability is not to be limited by the provided products.

2.2.2 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 Line Supervision

Provide the same geographic resolution for fault isolation at the systems level as provided for intrusion detection. Provide either a static or dynamic system with active mode for line supervision of communication links of the ESS.

- a. The static system must represent "no-alarm" always by the same signal, which is different than the originally transmitted signal.
- b. The dynamic system must represent "no-alarm" with a signal which continually changes with time.

2.2.7 Power Loss Detection

Detect AC and DC power loss and generate an alarm when a critical component of the system experiences temporary or permanent loss of power. Annunciate the alarm in the Secured Area and the Security Command Center to clearly identify the component experiencing power loss.

2.2.8 Controls and Designations

Provide controls and designations as specified in NEMA ICS 1.

2.2.9 Special Test Equipment

Provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

2.3 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.

- a. Provide both supervised and non-supervised alarm point monitoring.
- b. Arm or disarm 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 300 feet zones along a line or perimeter to one side of the facility 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 256 sensor zone alarms and to enable control of two integral keypads for arming and disarming inside of the protected area with a delayed alarm and outside of the protected area with instant 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, except that alarms transmitted by radio frequency signaling must communicate in less than 3 seconds.

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 16 keypads with alphanumeric display. Each keypad must be capable of arming and disarming securing and accessing 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. A total of at least 100 programmable output relay schedules.
- d. 64 individual reporting areas.
- e. Data line supervision or two separate lines of communication.
- f. Two-man access code or credentials.
- g. 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.
- h. 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.
- i. 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.
- j. 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.

Manufacture: Vindicator -V5 Intrusion Detection System or equivalent

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 secured and accessed 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

Manufacture: Magnasphere or equivalent as follows:

Magnasphere HSS-L2S-000 High-Security Sensor (HSS) Door Contact Switch, BMS,
 Magnasphere L2C-101 (Concealed switch) Magnetic Contact Switch,
 Magnasphere L2C 101A (Recessed Switch) Magnetic Contact Switch,
 Magnasphere HS-L1.5-101 BMS,
 Magnasphere HS-L1.5-111 BMS,
 Magnasphere HSS-L2C-111 BMS,
 Magnasphere HSS-L2C-111-A BMS,
 Magnasphere HSS-L2D-000 BMS,
 Magnasphere HSS-L2D-800 BMS,
 Magnasphere HSS-L2S-800 BMS,

2.3.7.1.2 Glass Break Detection

UL 639.

2.3.7.1.3 Passive Infrared Sensors

UL 639.

2.3.7.1.4 Dual Technology Sensors

UL 639. Provide sensor combining passive infrared (PIR) and microwave sensors configured and manufactured specifically to be mounted in a single tamper alarmed enclosure. The sensor must provide "AND" logic for alarm indication selectable "AND" logic or "OR" logic for alarm indication configured in the "OR" logic state. Provide sensors that have a local means of indicating detection for use during installation and calibration with a means of disabling the indication.

The sensor is to have an LED walk test indicator which is not visible during normal operations. When visible, the walk test indicator will light when the sensor detects an intruder. Provide a sensor equipped with a manual control, located within the sensor's housing, to enable and disable the test indicator or with the test indicator located within the sensor housing so that it can only be seen when the housing is open or removed.

Manufacture: Magnasphere Interior Motion Sensor Model MSK-101-MM, or equivalent.

2.3.7.2 Tamper Switches

- a. Corrosion-resistant tamper switches are required for the following IDS and CCTV equipment with hinged doors or removable covers that contain open circuits:

- (1) Enclosures
- (2) Cabinets
- (3) Housings
- (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. Provide two positions tamper switches.

2.3.7.2.1 Tamper Switch Performance Requirements

Tamper switches are to be:

- a. Inaccessible until switch is activated.
- b. Under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating.
- c. Annunciated to be clearly distinguishable from intrusion detection alarms and exempt from being disarmed, shunted, or silenced.
- d. Spring-loaded and held in the closed position by the door, or cover protected.
- e. Wired to break the circuit when the door or cover is disturbed.
- f. Wired so that each sensor and device is annunciated individually 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.

- a. The ACS card credentials are required to be Common Access Cards (CAC), and CAC cards are being provided by the Government. Interface system with and provide alarm and other status to the overall ESS. Provide 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 16 card readers and keypads per card reader controller, 512 alarm inputs, or 512 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. When used for elevator control, the ACS is to grant access to elevator floors based on a valid credential, or by schedule.
 - i. 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.
 - j. 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.

Manufacture:Vindicator-V5 ACS or equivalent.

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 Armed and Disarmed 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 two dedicated relay outputs. Both relays are to provide Normally Open and Normally Closed contacts. Use the first relay for electric lock control while the second is software configurable to activate for door forced open, door left open too long, duress, passback violations, invalid access attempts and valid unlock conditions. Allow for both relays to be separately programmable for energize times from 1 second to 10 minutes. The second relay must allow a delay time to be specified, causing its activation to be delayed after an activating condition occurs.

2.4.1.10 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 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 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. Locate a camera to view the card reader and interface to record the events 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 and USB 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 IDS 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 or RS-232 hardwired, TCP/IP or fiber-optic communication. 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 256 are to be designated as "Secondary" and communicate with the "Primary" via an RS-422/485 hardwire, TCP/IP network or fiber-optic configuration. 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 16 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 16 devices per ACU.

- d. Capability of supporting multiple card reader technologies

simultaneously, including:

- (1) Card and Keypad
- (2) CAC, PIV compatible

This capability must be an integral part of the ACU and will not require special external equipment.

- e. Built-in battery back-up of programmed information sustainable for a period of at least 90 days.
- f. Powered by a 12 or 24 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 4 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.

Manufacture: Vindicator-V5 ACS or equivalent.

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, semiflush, pedestal, or weatherproof mountable card readers as indicated for each individual location. Provide and contactless type card readers capable of reading Keypad CAC PIV and Keypad CAC PIV cards type of access control cards.

2.4.5.1.1 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.

2.4.5.1.2 Card Reader Display

Provide card readers with an LED or other visual indicator display which indicate power ON and OFF and whether user passage requests have been

accepted or rejected.

2.4.5.1.3 Card Reader Response Time

The card reader is to respond to passage requests by generating a signal to the local processor.

2.4.5.1.4 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.

2.4.5.1.5 Card Reader Mounting Method

Provide card readers suitable for surface, semi-flush, pedestal, or weatherproof mounting as required.

Manufacture: HID pivCLASS RPK40-H Model-921PHRNEK001U

2.4.5.2 Portal Control Devices

2.4.5.2.1 Push-Button Switches

- a. Provide momentary contact, back lit push buttons and stainless steel switch enclosures for each push button. Provide switch enclosures suitable for flush or surface mounting as required and push buttons suitable for flush mount in the switch enclosures. The push button switches are to meet the requirements of NEMA 250 for the area in which they are to be installed.
- b. Where multiple pushbuttons are housed within a single switch enclosure stack vertically with each push button switch labeled with 1/4 inch high text and symbols. The push button switches are to be connected to the local processor associated with the portal to which they are applied and operate the appropriate electric strike, electric bolt or other facility release device.
- c. The continuous current of the IDS circuit is to be no more than 50% of the continuous current rating of the device supplied. Provide push button switches with double-break silver contacts that will make 720 VA at 60 amperes and break 720 VA at 10 amperes.

2.4.5.2.2 Panic Bar

2.4.5.2.2.1 Emergency Egress With Alarm

Include a conspicuous warning sign with 1 inch high, red lettering notifying personnel that an alarm will be annunciated if the panic bar is operated.

Panic bar hardware operation is to generate an intrusion alarm. The panic bar must depend upon a mechanical connection only and not depend upon electric power for operation, except for local alarm annunciation and alarm communications.

2.4.5.2.2.2 Normal Egress

Panic bar hardware operation is not to generate an intrusion alarm. The panic bar must depend upon a mechanical connection only when exiting.

Provide the exterior, non-secure side of the door with an electrified thumb latch or lever to provide access after the credential I.D. authentication by the ESS.

Signal Switches: Strikes/bolts are to include signal switches indicating to the system when the bolt is not engaged or the strike mechanism is unlocked. The signal switches are to report a forced entry to the system.

2.4.5.2.2.3 Delay Egress With Alarm

Include a conspicuous warning sign with 1 inch high, red lettering notifying personnel that an alarm will be annunciated if the panic bar is operated.

Delay operation 15 seconds after initiation for portal control devices.

2.4.5.2.3 Electromagnetic Lock

Electromagnetic locks are to contain no moving parts and depend solely upon electromagnetism to secure a portal by generating at least 1200 pounds of holding force. Interface the lock with the local processors without external, internal or functional local processor alteration. Incorporate an end-of-line resistor to facilitate line supervision by the system. Install MOVs to protect the controller from reverse current surges if not incorporated into the electromagnetic lock or local controller. Provide in accordance of ANSI/BHMA A156.23.

2.4.5.2.3.1 Armature

The electromagnetic lock is to contain internal circuitry to eliminate residual magnetism and inductive kickback. The actuating armature must operate on 12 or 24 VDC and not dissipate more than 12 Watts. The holding current must be not greater than 500 milli-amperes. The actuating armature must take not more than 300 milli-seconds to change the status of the lock from fully secure to fully open or fully open to fully secure.

2.4.5.2.3.2 Tamper Resistance

The electromagnetic lock mechanism is to be encased in hardened guard barriers to deter forced entry.

2.4.5.2.3.3 Mounting Method

Provide electromagnetic lock suitable for use with single and double door installations with mortise-type hardware as indicated, and compatible with right or left hand mounting.

Manufacture:Dortronics 1110 xD xCT, Magnetic Lock/BMS,Dortronics 1120 x2D xCT, Series Electromagnetic Lock and BMS, Eltec 864 PIR or equivalent.

2.5 CLOSED-CIRCUIT TELEVISION (CCTV) SYSTEM

Select system components that conform to the Open Network Video Interface Forum (ONVIF) specification. Provide compatible UL listed CCTV components to provide visual assessment of ESS alarms automatically upon alarm or upon SCC operator selection. Otherwise, the subsystem is to continuously display the coverage area. Display alphanumeric camera location ID on all monitors. Provide the number of alarm monitors as required. The scene from each camera must appear clear, crisp, and stable on the respective

monitor during both daytime and nighttime operation. Provide component equipment that minimizes both preventive and corrective maintenance. Provide components from a single manufacturer or justify mixing manufacturer components and demonstrate compatibility in submittal information.

2.5.1 Cameras

2.5.1.1 CCTV Camera

Provide cameras of digital fixed, type as identified on the drawings.

- a. Day-Night Color fixed, cameras are to be used in all outdoor environments. Standard fixed, cameras are to be used for all indoor applications except when backlighting issues are observed. Use Day-Night cameras or standard cameras with backlighting compensation for backlighting or high contrast applications.
- b. Provide cameras that operate over a voltage range of 12 VDC, 24 VDC, 12, or 24 VAC at 50 or 60 Hz Power over Ethernet (PoE) IEEE 802.3.
- c. All cameras must be constructed to provide rigid support for electrical and optical systems so that unintentional changes in alignment or microphonic effects do not occur during operation, movement, or lens adjustments.
- d. Video Frame Rate: 30 frames per second (fps)
- e. Minimum essential requirements for cameras include the following:

2.5.1.1.1 Sensitivity

Minimum Illumination: 0.08 foot-candles at F1.4 color mode; 0.01 foot-candles at F1.4 in the B&W mode.

2.5.1.1.2 Signal-To-Noise Ratio

Show a signal-to-noise ratio of not less than 50 decibels (dB) at Automatic Gain Control (AGC) "Off", weight "On".

2.5.1.1.3 Resolution

Provide a minimum of 2.1 megapixel resolution. The imager must have a minimum of 1920 horizontal x 1080 picture in progressive scan format. Resolution is to be maintained over the specified input voltage and frequency range, and not vary from minimum specification over the specified operating temperature range.

2.5.1.1.4 Synchronization

Provide cameras that have internal and line lock.

2.5.1.1.5 Low Light Level

Provide Day-Night cameras that have a B-W mode that may be automatically engaged on low light level and permit the use of an external infrared illuminator. Electronic removal of the color signal is not acceptable. The camera must have an infrared cut filter capable of being removed automatically upon low light threshold or manually.

2.5.1.2 Camera Lenses

Camera lenses are to be all glass with coated optics. Provide lens mount that is C or CS mount, compatible with the cameras selected and integrated with the cameras. Provide lens with the camera that have a maximum f-stop opening of f/1.2 or the maximum available for the focal length specified. The lens is to have an auto-iris mechanism unless otherwise specified. Lenses having auto iris, manual iris, or zoom and focus functions are to be supplied with connectors, wiring, receiver and driver units, and controls as needed to operate the lens functions. Provide lenses with sufficient circle of illumination to cover the image sensor evenly. Lenses are not to be used on a camera with an image format larger than the lens is configured to cover. Provide lens with focal lengths as indicated or specified in the manufacturer's lens selection tables.

Manufacture:

Bosch DINION Internet Protocol (IP) Starlight 7000 HD (NBN-73013-BA),
 Bosch NBN-63013-B,
 Bosch NBN-63023-B,
 Bosch Flexi Dome Starlight 8000 Dual SD Variant must be used or WLAN Disabled,
 Bosch Auto Dome IP Starlight 7000i Camera (Model: NDP-7512-Z30).

2.5.1.3 Camera Housing and Mounts

The camera and lens are to be enclosed in a tamper resistant housing installed on a camera support. Any ancillary housing mounting hardware needed to install the housing at the camera location is to be provided as part of the housing. The camera support must be capable of supporting the mounted equipment and withstanding wind and ice loads normally encountered at the site.

2.5.1.3.1 Environmentally Sealed Camera Housing

The housing is to provide an environment needed for camera operation and be condensation free; dust and water tight; keep the viewing window free of fog, snow, and ice, and be fully operational in 100 percent condensing humidity. Provide housing equipped with a sunshield. Both the housing and sunshield are to be white. Purge the housing of atmospheric air and pressurized with dry nitrogen, equipped with a fill valve, overpressure valve, and include a humidity indicator visible from the exterior. Housing must not have a leak rate greater than 2 psi at sea level within a 90 day period.

Provide housing equipped with supplementary camera mounting blocks or supports needed to position the camera and lens to maintain the proper optical centerline. All electrical and signal connections required for camera and lens operation are to be supplied. Provide a mounting bracket as part of the housing which allows weight adjustment to center the weight of the assembly.

2.5.1.3.2 Indoor Camera Housing

Provide housing with a tamper resistant enclosure for indoor camera operation and with the proper mounting brackets for the specified camera and lens. The housing and appurtenances color are not to conflict with the building interior color scheme.

2.5.1.3.3 Interior Mount

Provide camera mount suitable for either wall or ceiling mounting and have an adjustable head for mounting the camera. The wall mount and head must be constructed of aluminum or steel with a corrosion-resistant finish. Provide adjustable head with 360 degrees of pan and plus or minus 90 degrees of tilt.

2.5.1.3.4 Low Profile Ceiling Mount

Provide tamperproof ceiling housing which is low profile and suitable for use in 2 by 2 foot ceiling tiles. The housing must be equipped with a camera mounting bracket and allows a 360 degree viewing setup.

2.6 SECURITY COMMAND CENTER (SCC)

The SCC must integrate all subsystems and communications, and provide operator control interface to the ESS system. The components are as follows:

- a. ESS Software
- b. Monitoring Display Software
- c. Graphical Map Software
- d. Printers
- e. Controls and Display Integration
- f. Enrollment Center Equipment

2.6.1 ESS Software

- a. Provide commercial off-the-shelf ESS software that utilizes a single database for the subsystem integrations provided under a single operating environment. The system is to archive all events in a database stored either on a local hard drive or a networked database server. The software has to support configuration and simultaneous monitoring of all subsystems.
- b. Allow the networked PC workstation configurations connected via a TCP/IP network. Administrative tasks including configuration, monitoring, schedules, report generation and graphic display are provided from any PC workstation on the network. All system programming data must be instantly accessible to every PC Workstation connected to the network. The system is to utilize a non-proprietary SQL-based, ODBC-compliant database, managed by Sybase Adaptive Server Anywhere, Microsoft SQL Server, or Oracle.
- c. Utilize a preemptive multi-tasking operating system, such as the latest Microsoft Windows 10 Professional environment, that is multitasking, with many processes running at the same time without interference with each other and with higher priority tasks taking precedence over lower priority tasks.
- d. Provide capabilities to define visual exclusion areas.

2.6.1.1 Alarm Call up

Support responses to alarms entering the system with each alarm capable of initiating one or more of the following actions:

- a. Sending alarm commands to a CCTV system interface
- b. Activating output devices
- c. Playing PC audio files
- d. Controlling doors
- e. Display graphical maps associated with the alarm device

Provide mode of system operation that requires an operator to acknowledge any alarm. While alarm is still active, the alarm cannot be cleared.

2.6.1.2 Programming

Provide the capability of, but not limited to, the following programming and functionality:

2.6.1.2.1 Daylight Savings Time Adjustment

The ACU(s) and PCU(s) must not need to be connected to the ESS in order for the adjustment to occur.

2.6.1.2.2 Operator Privileges

Support an unlimited number of system operators, each with a unique login and password combination. Operators are to be assigned privileges based on the loops, commands, or programming features that are available to each individual operator.

2.6.1.2.3 Alarm Priorities

Provide the ability for each alarm device to be user configured to belong to one of 10,000 priority levels which are assigned to an alarm based on alarm importance. These priorities are to define which alarm events to display on individually specified ESS workstations.

2.6.1.2.4 Reports

Include integrated reporting capabilities as well as the ability to run Crystal Report templates.

2.6.1.2.5 User Interface

The ESS programming is to be menu-driven, with "wizards" to assist with software configuration, and include 'Help' information.

2.6.1.2.6 Messages

Permit the use of user-selected colors for event messages.

2.6.1.2.7 Graphics

Provide the capability to display a floor-plan graphic for card activity

and alarm events as part of the ESS integration.

2.6.1.2.8 Device Status

Provide the capability to display the dynamic status of a user-selected list of devices, including doors, inputs, and outputs.

2.6.1.2.9 Diagnostics

Include diagnostic software tools that interface and query the hardware for information and to issue commands.

2.6.1.2.10 Mandatory Data Fields

Require any cardholder data field to be selected by the user as mandatory.

2.6.1.2.11 User Defined Data Fields

Provide 20 unassigned data fields for storing user-defined data that support user-defined labels, and are user-configurable as plain text fields or drop-down selection lists.

2.6.1.2.12 Archive Database

Include a connection to an archive database which stores purged events and deleted programming and which can be accessed for reporting.

2.6.1.2.13 Programmable Database Backup

Include the capability of performing user-scheduled database backups without the use of third-party backup software.

2.6.1.2.14 Programmable Database Purging

Include the capability of performing user-scheduled database purging, moving selected events to an archive database when the events have aged a user-specified number of days.

2.6.1.2.15 Database Importing

Include the capacity to import user data from an ODBC data source (Access, Excel, text).

2.6.1.2.16 Data Exporting

Include the capacity to export data from any table in the database to either a text, HTML, Excel, or Access file in any user-selected order.

2.6.1.2.17 Event Log Output

Include the capacity to send a continuous stream of user-selected types of event messages to a text file, serial port, or TCP/IP address.

2.6.1.2.18 Data Audit Trail

Record changes to programming, recording the date and time stamp of the change, the name of the operator making the change, and the nature of the change. This data audit is to be available in history for reporting.

Manufacture: ExaqVision System, provided by Government.

2.7 COMMUNICATIONS

2.7.1 Hardwire

2.7.1.1 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 rigid galvanized steel conduit installed in electrical metallic tubing (EMT). 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 for interior applications with additions and modifications specified. Conductors are to be copper. Conductors for links which also carry AC voltage, are to be No. 12 AWG minimum; single conductors for low-voltage DC links are to be No. 14 or 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.

2.7.1.2 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 (one pair for interrogation and one for response), which may have one or more parallel branches. Individual control unit lines are to be at least 22 AWG wire. Connect control wires in

parallel to the hardwire link. Communication system is to provide as many as 255 control unit connections.

- c. The communication system must maintain specified performance over a link length of 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 four 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

2.7.2 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.

2.7.3 Network Switch

Note: Provided by the Government.

2.7.4 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.

2.7.5 Local Area Network (LAN) Cabling

Cabling must be in accordance with TIA-568-C.2, Category 6.

2.7.6 Cable Construction

Provide all cable components that will withstand the environment in which the cable is installed for a minimum of 20 years.

2.8 SURVEILLANCE AND DETECTION EQUIPMENT

2.8.1 Metal Detector

2.8.1.1 Electrical

The metal detector must not dissipate more than 250 Watts. Neither the metal detector's sensitivity nor its functional capability is to be adversely affected by power line voltage variations of plus or minus 10 percent or less from nominal values.

2.9 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.

2.9.1 Uninterruptible Power Supply (UPS)

Backup power required for uninterrupted ESS operation until a diesel engine generator set can assume the full load is to be provided by a UPS.

The UPS is to consist of a rectifier, battery and support racks, a static inverter, static switch transfer, and a manual bypass switch. Provide UPS with a continuous output to supply the maximum load requirements of the ESS. Size the battery to sustain the UPS at full rated load for 15 minutes.

2.9.2 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 4 hours without recharge or replacement.

2.10 COMPONENT ENCLOSURE

2.10.1 Interior Enclosures

Enclosures to house equipment in an interior environment must meet the requirements of NEMA 250 Type 12 and 1.

2.10.2 Exposed-to-Weather Enclosures

Enclosures to house equipment in an outdoor environment must meet the requirements of NEMA 250 Type 4X.

2.10.3 Corrosion-Resistant Enclosures

Enclosures to house equipment in a corrosive environment must meet the requirements of NEMA 250 Type 4X.

2.10.4 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."

2.10.5 Ventilation

Ventilation openings in enclosures and cabinets must conform to requirements of UL 1610.

2.10.6 Mounting

Sheet metal enclosures are to be rated for wall mounting with top hole slotted, unless otherwise indicated. Mounting holes are to be in positions which remain accessible when major operating components are in place and door is open, and be inaccessible when door is closed.

2.10.7 Labels

Label boxes containing connections that they contain ESS connections and indicate that the box is part of the ESS system.

2.10.8 Test Points

Provide readily visible and accessible with minimum disassembly of equipment to test points, controls, and other adjustments inside enclosures. Test points and other maintenance controls must be readily accessible to operator personnel.

2.11 LOCKS AND KEY LOCK

2.11.1 Lock

Provide locks on system enclosures for maintenance purposes that meet UL 437 .

2.11.2 Key-Lock Operated Switches

All key-lock-operated switches required to be installed on system components are to be UL 437.

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.

3.1.3 Cable and Wire Runs

Perform required cable and wire routings per NFPA 70 and 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.

3.1.4 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.

3.2 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

3.6.1 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 2 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.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

SECTION 28 31 76

INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE

08/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED SECTIONS
- 1.3 SUMMARY
 - 1.3.1 Scope
 - 1.3.2 Qualified Fire Protection Engineer (QFPE)
- 1.4 DEFINITIONS
 - 1.4.1 Interface Device
 - 1.4.2 Fire Alarm and Mass Notification Control Unit (FMCU)
 - 1.4.3 Remote Fire Alarm and Mass Notification Control Unit
 - 1.4.4 Local Operating Console (LOC)
 - 1.4.5 Terminal Cabinet
 - 1.4.6 Control Module and Relay Module
 - 1.4.7 Designated Fire Protection Engineer (DFPE)
 - 1.4.8 Qualified Fire Protection Engineer (QFPE)
- 1.5 SUBMITTALS
- 1.6 SYSTEM OPERATION
 - 1.6.1 Alarm Initiating Devices and Notification Appliances (Visual, Voice, Textual)
 - 1.6.2 Functions and Operating Features
 - 1.6.3 Elevator Recall
- 1.7 TECHNICAL DATA AND SITE-SPECIFIC SOFTWARE
- 1.8 QUALITY ASSURANCE
 - 1.8.1 Submittal Documents
 - 1.8.1.1 Preconstruction Submittals
 - 1.8.1.2 Shop Drawings
 - 1.8.1.3 Nameplates
 - 1.8.1.4 Wiring Diagrams
 - 1.8.1.5 System Layout
 - 1.8.1.6 Notification Appliances
 - 1.8.1.7 Initiating Devices
 - 1.8.1.8 Amplifiers
 - 1.8.1.9 Battery Power
 - 1.8.1.10 Voltage Drop Calculations
 - 1.8.1.11 Product Data
 - 1.8.1.12 Operation and Maintenance (O&M) Instructions
 - 1.8.1.13 As-Built Drawings
 - 1.8.2 Qualifications
 - 1.8.2.1 Fire Alarm System Designer
 - 1.8.2.2 Supervisor
 - 1.8.2.3 Technician
 - 1.8.2.4 Installer
 - 1.8.2.5 Test Technician
 - 1.8.2.6 Manufacturer
 - 1.8.3 Regulatory Requirements

- 1.9 DELIVERY, STORAGE, AND HANDLING
- 1.10 MAINTENANCE
 - 1.10.1 Spare Parts
 - 1.10.2 Special Tools

PART 2 PRODUCTS

- 2.1 GENERAL PRODUCT REQUIREMENT
- 2.2 MATERIALS AND EQUIPMENT
 - 2.2.1 Standard Products
 - 2.2.2 Nameplates
 - 2.2.3 Keys
 - 2.2.4 Instructions
- 2.3 FIRE ALARM AND MASS NOTIFICATION CONTROL UNIT
 - 2.3.1 Cabinet
 - 2.3.2 Silencing Switches
 - 2.3.2.1 Alarm Silencing Switch
 - 2.3.2.2 Supervisory/Trouble Silencing Switch
 - 2.3.3 Non-Interfering
 - 2.3.4 Audible Notification System
 - 2.3.4.1 Outputs and Operational Modules
 - 2.3.4.2 Mass Notification
 - 2.3.5 Memory
 - 2.3.6 Field Programmability
 - 2.3.7 Input/Output Modifications
 - 2.3.8 Resetting
 - 2.3.9 Walk Test
 - 2.3.10 History Logging
 - 2.3.11 Manual Access
 - 2.3.12 Heat Detector Self-Test Routines
- 2.4 LOCAL OPERATING CONSOLES (LOC)
 - 2.4.1 General
 - 2.4.2 Multiple LOCs
- 2.5 AMPLIFIERS, PREAMPLIFIERS, TONE GENERATORS
 - 2.5.1 Operation
 - 2.5.2 Construction
 - 2.5.3 Inputs
 - 2.5.4 Tone Generator
 - 2.5.5 Protection Circuits
- 2.6 REMOTE ANNUNCIATOR
 - 2.6.1 LCD Annunciator
- 2.7 MANUAL STATIONS
- 2.8 SMOKE DETECTORS
 - 2.8.1 Spot Type Detectors
 - 2.8.2 Duct Smoke Detectors
- 2.9 HEAT DETECTORS
 - 2.9.1 Heat Detectors
 - 2.9.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors
 - 2.9.1.2 Rate Compensating Detectors
 - 2.9.1.3 Fixed Temperature Detectors
- 2.10 MULTI-CRITERIA DETECTORS
- 2.11 CARBON MONOXIDE DETECTOR
- 2.12 ADDRESSABLE INTERFACE DEVICES
- 2.13 ADDRESSABLE CONTROL MODULES
- 2.14 ISOLATION MODULES
- 2.15 NOTIFICATION APPLIANCES
 - 2.15.1 Audible Notification Appliances
 - 2.15.1.1 Speakers
 - 2.15.2 Visual Notification Appliances

- 2.15.3 Textual Display Signs
- 2.16 ELECTRIC POWER
 - 2.16.1 Primary Power
- 2.17 SECONDARY POWER SUPPLY
 - 2.17.1 Batteries
 - 2.17.1.1 Capacity
 - 2.17.1.2 Battery Power Calculations
 - 2.17.2 Battery Chargers
- 2.18 SURGE PROTECTIVE DEVICES
- 2.19 WIRING
 - 2.19.1 Alarm Wiring
- 2.20 INTERFACE TO THE BASE-WIDE MASS NOTIFICATION NETWORK
 - 2.20.1 Radio
 - 2.20.2 Telephone
 - 2.20.3 Secure Radio System
 - 2.20.3.1 Communications Network
 - 2.20.3.2 Licensed Radio Frequency Systems
- 2.21 AUTOMATIC FIRE ALARM TRANSMITTERS
 - 2.21.1 Digital Alarm Communicator Transmitter (DACT)
 - 2.21.2 Signals to Be Transmitted to the Base Receiving Station
- 2.22 SYSTEM MONITORING
 - 2.22.1 Valves

PART 3 EXECUTION

- 3.1 VERIFYING ACTUAL FIELD CONDITIONS
- 3.2 INSTALLATION
 - 3.2.1 Fire Alarm and Mass Notification Control Unit (FMCU)
 - 3.2.2 Battery Cabinets
 - 3.2.3 Manual Stations
 - 3.2.4 Notification Appliances
 - 3.2.5 Smoke and Heat Detectors
 - 3.2.6 Carbon Monoxide Detectors
 - 3.2.7 LCD REMOTE Annunciator
 - 3.2.8 Local Operating Console (LOC)
 - 3.2.9 Ceiling Bridges
- 3.3 SYSTEM FIELD WIRING
 - 3.3.1 Wiring within Cabinets, Enclosures, and Boxes
 - 3.3.2 Terminal Cabinets
 - 3.3.3 Alarm Wiring
 - 3.3.4 Back Boxes and Conduit
 - 3.3.5 Conductor Terminations
- 3.4 CONNECTION OF NEW SYSTEM
- 3.5 FIRESTOPPING
- 3.6 PAINTING
- 3.7 FIELD QUALITY CONTROL
 - 3.7.1 Test Procedures
 - 3.7.2 Pre-Government Testing
 - 3.7.2.1 Verification of Compliant Installation
 - 3.7.2.2 Request for Government Final Test
 - 3.7.3 Correction of Deficiencies
 - 3.7.4 Government Final Tests
- 3.8 MINIMUM SYSTEM TESTS
 - 3.8.1 System Tests
 - 3.8.2 Audibility Tests
 - 3.8.3 Intelligibility Tests
- 3.9 SYSTEM ACCEPTANCE
- 3.10 INSTRUCTION OF GOVERNMENT EMPLOYEES
 - 3.10.1 Instructor

- 3.10.2 Required Instruction Time
- 3.10.3 Technical Training Manual
- 3.11 EXTRA MATERIALS
 - 3.11.1 Repair Service/Replacement Parts
 - 3.11.2 Spare Parts
 - 3.11.3 Document Storage Cabinet

-- End of Section Table of Contents --

SECTION 28 31 76

INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM, ADDRESSABLE
08/20

PART 1 GENERAL

1.1 REFERENCES

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

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S3.2 (2009; R 2014) Method for Measuring the
Intelligibility of Speech Over
Communication Systems (ASA 85)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1/CSA B44 (2021) Safety Code for Elevators and
Escalators

FM GLOBAL (FM)

FM APP GUIDE (updated on-line) Approval Guide
<http://www.approvalguide.com/>

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1 (2002; R 2008) Guide on the Surges
Environment in Low-Voltage (1000 V and
Less) AC Power Circuits

IEEE C62.41.2 (2002) Recommended Practice on
Characterization of Surges in Low-Voltage
(1000 V and Less) AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 4 (2018) Standard for Integrated Fire
Protection and Life Safety System Testing

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA
20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

NFPA 72 (2019; TIA 19-1; ERTA 1 2019) National
Fire Alarm and Signaling Code

NFPA 90A (2021) Standard for the Installation of
Air Conditioning and Ventilating Systems

NFPA 170 (2021) Standard for Fire Safety and
Emergency Symbols

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-601-02	(2010) Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems
UFC 4-010-06	(2016; with Change 1, 2017) Cybersecurity of Facility-Related Control Systems
UFC 4-021-01	(2008; with Change 1, 2010) Design and O&M: Mass Notification Systems

UNDERWRITERS LABORATORIES (UL)

UL 268	(2016; Reprint Oct 2019) UL Standard for Safety Smoke Detectors for Fire Alarm Systems
UL 268A	(2008; Reprint Oct 2014) Smoke Detectors for Duct Application
UL 464	(2016; Reprint Sep 2017) UL Standard for Safety Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories
UL 497A	(2001; Bul. 2019) UL Standard for Safety Secondary Protectors for Communications Circuits
UL 497B	(2004; Reprint Dec 2012) Protectors for Data Communication Circuits
UL 521	(1999; Reprint Mar 2021) UL Standard for Safety Heat Detectors for Fire Protective Signaling Systems
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 Sep 2018) UL Standard for Safety Single and Multiple Station Carbon Monoxide Alarms
UL 2075	(2013; Bul. 2019) UL Standard for Safety Gas and Vapor Detectors and Sensors
UL 2572	(2016; Bul. 2018) UL Standard for Safety Mass Notification Systems
UL Fire Prot Dir	(2012) Fire Protection Equipment Directory

1.2 RELATED SECTIONS

Section 25 05 11.28 Cybersecurity for Facility-Related Control 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 08 71 00 DOOR HARDWARE for door releasedoor unlocking and additional work related to finish hardware.
 Section 14 24 23 HYDRAULIC PASSENGER ELEVATORS for additional work related to elevators.
 Section 07 84 00 FIRESTOPPING for additional work related to firestopping.

1.3 SUMMARY

1.3.1 Scope

- a. This work includes designing and providing a new, complete, fire alarm and mass notification (MNS) system as described herein and on the contract drawings. Include system wiring, raceways, pull boxes, 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 25 05 11.28, 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. Where an emergency generator provides standby power supply for life safety system circuits, the generator must be monitored by the FMCU and transmit emergency generator signals in accordance with NFPA 72.
- e. The fire alarm and mass notification system must be independent of the building security, building management, and energy/utility monitoring systems other than for control functions.

1.3.2 Qualified Fire Protection Engineer (QFPE)

Services of the QFPE must include:

- a. Reviewing SD-02, SD-03, and SD-05 submittal packages for completeness and compliance with the provisions of this specification. 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 information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.

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

Fire alarm system designer; G

Supervisor; G

Technician; G

Installer; G

Test Technician; G

Fire Alarm System Site-Specific Software Acknowledgement; G

SD-02 Shop Drawings

Nameplates; G

Instructions; G, AE

Wiring Diagrams; G, AE

System Layout; G, AE

Notification Appliances; G, AE

Initiating devices; G, AE

Amplifiers; G, AE

Battery Power; G, AE

Voltage Drop Calculations; G, AE

SD-03 Product Data

Fire Alarm and Mass Notification Control Unit (FMCU); G, AE

Local Operating Console (LOC); G, AE

Amplifiers; G, AE

Tone Generators; G, AE

Digitalized voice generators; G, AE

LCD Annunciator; G, AE

Manual Stations; G, AE

Smoke Detectors; G, AE

Duct Smoke Detectors; G, AE

Heat Detectors; G, AE

Multi-Criteria Detectors; G, AE

Carbon monoxide detector; G, AE

Addressable Interface Devices; G, AE

Addressable Control Modules; G, AE

Isolation Modules; G, AE

Notification Appliances; G, AE

Textual Display Sign Control Panel; G, AE

Textual Display Signs; G, AE

Batteries; G, AE

Battery Chargers; G, AE

Supplemental Notification Appliance Circuit Panels; G, AE

Auxiliary Power Supply Panels; G, AE

Surge Protective Devices; G, AE

Alarm Wiring; G, AE

Back Boxes and Conduit; G, AE

Ceiling Bridges for Ceiling-Mounted Appliances; G, AE

Terminal Cabinets; G, AE

Digital Alarm Communicator Transmitter (DACT); G, AE

Automatic Fire Alarm Transmitters (including housing); G, AE

Radio Transmitter and Interface Panels; G, AE

Mass Notification Transceiver; G, AE

Document Storage Cabinet; G, AE

SD-06 Test Reports

Test Procedures; G

SD-07 Certificates

Verification of Compliant Installation; G

Request for Government Final Test; G

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

Instruction of Government Employees; G

SD-11 Closeout Submittals

As-Built Drawings

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.

Ensure that a single impairment cannot adversely affect more than one floor.

1.6.1 Alarm Initiating Devices and Notification Appliances (Visual, Voice, Textual)

- a. Connect alarm initiating devices to initiating device circuits (IDC) Class "A", or to signaling line circuits (SLC) Class "A" and installed in accordance with NFPA 72.
- b. Connect notification appliances to notification appliance circuits (NAC) Class "A".

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, and elevator recall features. Operation of this programmed action must indicate on the FMCU display and printer output 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 or elevator recall, 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, and on the remote annunciator.
 - (3) Record the event on the system printer.
 - (4) Actuation of alarm notification appliances.
 - (5) Recording of the event electronically in the history log of the FMCU.
 - (6) Elevator recall as described in this section.
 - (7) Operation of a sprinkler waterflow switch serving an elevator machinery room or elevator shaft must operate shunt trip circuit breaker(s) to shut down power to the elevators in accordance with ASME A17.1/CSA B44.
- m. A supervisory signal must automatically initiate the following functions:
 - (1) Visual indication of the device operated on the FMCU, and on the remote annunciator.
 - (2) Record the event on the system printer.
 - (3) Transmission of a supervisory signal to the fire department.
 - (4) 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.

- (5) 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, and on the remote annunciator.
 - (2) Record the event on the system printer.
 - (3) Transmission of a trouble signal to the fire department.
 - (4) 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, and on the remote annunciator.
 - (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.

1.6.3 Elevator Recall

Provide elevator recall in accordance with ASME A17.1/CSA B44, Section 14 24 23 HYDRAULIC PASSENGER ELEVATORS, and as specified herein. Activation of any smoke detector in an elevator shaft, machine room, or lobby (except at designated recall level) must cause all elevators associated with that shaft, machine room, or lobby to return nonstop to the designated level. Activation of a smoke detector in the lobby or machine room at the designated level must cause all elevators associated with that lobby to return nonstop to the assigned alternate level. Activation of a detector in an elevator shaft, machine room, or lobby must also cause illumination of elevator cab warning signal (fire hat) and complete operation of fire alarm system as specified in paragraph titled "Functions and Operating Features".

1.7 TECHNICAL DATA AND SITE-SPECIFIC SOFTWARE

Technical data and site-specific software (meaning technical data that relates to computer software) that are specifically identified in this project, and may be required in other specifications, must be delivered, strictly in accordance with the CONTRACT CLAUSES. The fire alarm system manufacturer must submit written confirmation of this contract provision as "Fire Alarm System Site-Specific Software Acknowledgement". Identify data delivered by reference to the specification paragraph against which it is furnished. Data to be submitted must include complete system, equipment, and software descriptions. Descriptions must show how the equipment will operate as a system to meet the performance requirements of this contract. The site-specific software data package must also include the following:

- a. Items identified in NFPA 72, titled "Site-Specific Software".
- b. Identification of programmable portions of the system equipment and capabilities.
- c. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- d. Provision of operational software data on all modes of programmable portions for fire alarm and mass notification.
- e. Description of Fire Alarm and Mass Notification Control Unit equipment operation.
- f. Description of auxiliary and remote equipment operations.
- g. Library of application software.
- h. Operation and maintenance manuals.

1.8 QUALITY ASSURANCE

1.8.1 Submittal Documents

1.8.1.1 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.

1.8.1.2 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'.

1.8.1.3 Nameplates

Nameplate illustrations and data to obtain approval by the Contracting Officer before installation.

1.8.1.4 Wiring Diagrams

Six 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.

1.8.1.5 System Layout

Six 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.

1.8.1.6 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.

1.8.1.7 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.

1.8.1.8 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.

1.8.1.9 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.

1.8.1.10 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.

1.8.1.11 Product Data

Six 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.

1.8.1.12 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.

1.8.1.13 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.

1.8.2 Qualifications

1.8.2.1 Fire Alarm System Designer

The fire alarm system designer must be certified as a Level III (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.

1.8.2.2 Supervisor

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.

1.8.2.3 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.

1.8.2.4 Installer

Fire alarm installer with a minimum of two years of experience utilized 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.

1.8.2.5 Test Technician

Fire alarm technicians with a minimum of eight years of experience and NICET Level III or 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.

1.8.2.6 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.

1.8.3 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.

1.9 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity, and temperature variation, dirt and dust, and other contaminants.

1.10 MAINTENANCE

1.10.1 Spare Parts

Furnish the following spare parts in the manufacturers original unopened containers:

- a. Five complete sets of system keys.
- b. Two of each type of fuse required by the system.
- c. One manual stations.
- d. Two of each type of detector installed.
- e. Two of each type of detector base and head installed.
- f. Two of each type of audible and visual alarm device installed.
- g. One textual visual notification appliance.
- h. Two of each type of addressable monitor module installed.
- i. Two of each type of addressable control module installed.
- j. Two low voltage, ethernet, and one 120 VAC surge protective device.
- k. One spare elevator reset key.

1.10.2 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 frame in a conspicuous location observable from 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. If more than a single unit is required, and is located in the lobby/entrance, notify the Contracting Officer's Designated Representative (COR), prior to installing the equipment. 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 throughout or all call. The system must be capable of operating all speakers at the same time. The public address paging function must not override any fire alarm or mass notification functions. The microphone must be hand-held style. Hand-held microphones must be housed in a separate protective cabinet. The cabinet must be accessible without the use of a key. The location of the microphone(s) must be approved by the Designated Fire Protection Engineer (DFPE). Activation of the public address microphone must not initiate activation of visual notification appliances or LED text displays.
- 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 shall be in accordance with UFC 4-021-01. 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, and public address (PA) functions. Other fire alarm functions including transmission of a signal(s) to the fire department must remain operational. When a mass notification announcement is disengaged and a fire alarm condition still exists, the audible and visual notification appliances must resume activation for alarm conditions. The fire alarm message must be of lower priority than all other messages (except any "test" messages) and must not override any other messages.
- c. Messages must be recorded professionally utilizing standard industry methods, in a professional male 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 following unless Installation or Facility specific messages are required:
 - (1) "May I have your attention please. May I have your attention please. Insert installation specific message here." (Provide a 2 second pause.) "May I have your attention please, (repeat the tones and message on a continuous loop).
 - (2) Carbon Monoxide: "May I have your attention please. May I have your attention please. Carbon monoxide has been detected in the building. Please walk to the nearest exit and leave the building." (Provide a 2 second pause.) "May I have your attention please, (repeat the tones and message on a continuous loop)."
 - (3) Fire: "May I have your attention please. May I have your attention please. A fire emergency has been reported in the building. Please leave the building by the nearest exit or exit stairway. Do not use the elevators." (Provide a 2 second pause.) "May I have your attention please, (repeat the tones and message on a continuous loop)."
 - (4) Test: "May I have your attention please. May I have your attention please. This is a test of the building mass notification system. Please continue your normal duties. This is only a test." (Provide a 2 second pause.)
 - (5) All Clear: "May I have your attention please. May I have your attention please. An all clear has been issued, resume normal activities." (Provide a 2 second pause.)

- 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 and on the system printer, 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).

2.3.12 Heat Detector Self-Test Routines

Automatic self-test routines must be performed on each detector that will functionally check detector sensitivity electronics and ensure the accuracy of the value being transmitted. Any detector that fails this test must indicate a trouble condition with the detector location at the control unit.

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. The LOC must have public address capability with the provision of a separate microphone. The PA paging function must not override any alarm or notification functions. The PA microphone must be hand-held style. Hand-held microphones must be housed in a separate protective cabinet. The cabinet must be accessible without the use of a key. The location of the microphones must be approved by the Designated Fire Protection Engineer (DFPE). Activation of the PA microphone must not initiate activation of visual notification appliances or LED text displays. The PA paging function must not override any alarm or notification functions.

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 except those installed in the stairs and within elevator cabs. The speakers in the stairs and elevator cabs must operate only when the microphone is used to deliver live messages.

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 on the system printer, and other actions for trouble conditions as specified.

2.6 REMOTE ANNUNCIATOR

2.6.1 LCD Annunciator

Provide a semi-recessed flush mounted annunciator that includes an LCD display. The display must indicate the device in trouble/alarm or any supervisory device. Display the device name, address. The remote annunciator must duplicate functions of the FMCU for message display, fire alarm, supervisory alarm, and trouble conditions, visual and audible notification, and system reset functions. Remote annunciator must require the use of a key for accessing the reset, control and other functions.

A building floor plan must be provided and mounted (behind Plexiglass or similar protective material) at the annunciator location. The floor plan must indicate all rooms by name and number including the locations of stairs and elevators. The floor plan must show all devices and their programmed address to facilitate identification of their physical location from the LCD display information.

2.7 MANUAL STATIONS

Provide metal or plastic, 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.

2.8 SMOKE DETECTORS

2.8.1 Spot Type Detectors

Provide addressable photoelectric smoke detectors as follows:

- a. Provide analog/addressable photoelectric smoke detectors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke detectors must be listed for use with the 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, and its sensitivity setting. Detectors must be of the low voltage type rated for use on a 24 VDC system.

2.8.2 Duct Smoke Detectors

Duct-mounted addressable photoelectric smoke detectors must consist of a smoke detector, as specified in paragraph Spot Type Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry must be mounted in a metallic or plastic enclosure exterior to the duct. It is not permitted to cut the duct insulation to install the duct. 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.

2.9 HEAT DETECTORS

2.9.1 Heat Detectors

Heat detectors must be analog/addressable and designed for detection of fire by combination fixed temperature and rate-of-rise principle in accordance with UL 521. The alarm condition must be determined by comparing detector value with the stored values.. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations as defined by NFPA 70, must be types approved for such locations.

2.9.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors must be surface mounted in the horizontal orientation and supported independently of wiring connections. Detectors must be self-resetting. Detector must operate at 135 degrees F. Detector must feature rate compensation. Detectors rated to operate at 135 degrees F must not respond to momentary temperature fluctuations less than 30 degrees F per minute between 60 and 100 degrees F.

2.9.1.2 Rate Compensating Detectors

Detector backbox must be surface mounted in the horizontal orientation and supported independently of wiring connections. Detectors must be self-restoring and hermetically sealed.

2.9.1.3 Fixed Temperature Detectors

Detectors must be surface mounted in the horizontal orientation and supported independently of wiring connections. Detectors must be self-restoring. The detectors must have a specific temperature setting of 135 degrees F.

2.10 MULTI-CRITERIA DETECTORS

Multi-criteria detectors must contain rate-of-rise heat sensor and photoelectric smoke detectorelements in a single housing.

2.11 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. 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.

2.12 ADDRESSABLE INTERFACE DEVICES

The initiating device being monitored must be configured as a Class "A" 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.

2.13 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 A 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.

2.14 ISOLATION MODULES

- a. Provide isolation modules to subdivide each signaling line circuit into groups of not more than 20 addressable devices each floor 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.

2.15 NOTIFICATION APPLIANCES

2.15.1 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 red. Recessed audible appliances must be installed with a grill that is painted with a factory finish to match the surface to which it is mounted.

2.15.1.1 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.

2.15.2 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 candela based on the UL 1971 test. Strobe must be surface mounted.

2.15.3 Textual Display Signs

Textual display signs must be LED 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.

- a. During non-emergency periods, display date and time.

2.16 ELECTRIC POWER

2.16.1 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.

2.17 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.

2.17.1 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.

2.17.1.1 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.

2.17.1.2 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.

2.17.2 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.

2.18 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.

2.19 WIRING

Provide wiring materials under this section as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM with the additions and modifications specified herein.

2.19.1 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. 16 AWG size conductors at a minimum. Visual notification appliance circuit conductors, that contain audible alarm appliances, must be copper No. 14 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.

2.20 INTERFACE TO THE BASE-WIDE MASS NOTIFICATION NETWORK

2.20.1 Radio

The mass notification transceiver must be bi-direction and meet all the requirements of paragraph, RADIO TRANSMITTER AND INTERFACE PANELS as specified in this specification section. The transceiver utilized in the mass notification system must be capable of the following:

- a. Communication with the central control/monitoring system to provide supervision of communication link and status changes are reported by automatic and manual poll/reply/acknowledge routines.
- b. All monitored points/status changes are transmitted immediately and at programmed intervals until acknowledged by the central control/monitoring system.
- c. Each transceiver must transmits a unique identity code as part of all messages; the code is set by the user at the transceiver.

2.20.2 Telephone

A modem must be provided for communication with the central

control/monitoring system. The modem must be 56k, compatible with data mode V.90, utilizing Hayes compatible command codes. The modem must be capable of auto dialing a preset number based on preprogrammed events. The modem must auto answer and provide a secure password protection system.

2.20.3 Secure Radio System

2.20.3.1 Communications Network

The communications network provides two-way signals between central control units and autonomous control units (in individual building systems), and should include redundant (primary and backup) communication links. The system must incorporate technology to prevent easy interruption of the radio traffic for MNS alerting.

2.20.3.2 Licensed Radio Frequency Systems

An approved DD Form 1494 for the system is required prior to operation.

2.21 AUTOMATIC FIRE ALARM TRANSMITTERS

2.21.1 Digital Alarm Communicator Transmitter (DACT)

Provide DACT that is compatible with the existing supervising station fire alarm system. Transmitter must have a means to transmit alarm, supervisory, and trouble conditions via a single transmitter. Transmitter must have a source of power for operation that conforms to NFPA 72. Transmitter must be capable of initiating a test signal daily at any selected time. Transmitter must be arranged to seize telephone circuits in accordance with NFPA 72.

2.21.2 Signals to Be Transmitted to the Base Receiving Station

The following signals must be sent to the base receiving station:

- a. Sprinkler waterflow
- b. Manual pull stations
- c. Smoke detectors
- d. Duct smoke detectors
- e. Carbon monoxide detectors
- f. Heat detectors
- g. Sprinkler valve supervision

2.22 SYSTEM MONITORING

2.22.1 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.

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. Surface mount 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 where indicated and to meet the intelligibility requirements. Where two or more visual notification appliances are located in the same room or corridor or field of view, provide synchronized operation. Devices must use screw terminals for all field wiring. Audible and visual notification appliances mounted in acoustical ceiling tiles must be centered in the tiles plus or minus 2 inches.

- b. Audible and visual notification appliances mounted on the exterior of the building, within unconditioned spaces, or in the vicinity of showers must be listed weatherproof appliances installed on weatherproof backboxes.
- c. Speakers must not be located in close proximity to the FMCU or LOC so as to cause feedback when the microphone is in use.

3.2.5 Smoke and Heat Detectors

Locate detectors as indicated on the drawings 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. Install smoke detectors no closer than 3 feet from air handling supply diffusers. Detectors installed in acoustical ceiling tiles must be centered in the tiles plus or minus 2 inches.

3.2.6 Carbon Monoxide Detectors

Locate detectors as indicated on the drawings on a 4-inch mounting box. Carbon monoxide detectors must be installed separate from smoke and/or heat detectors.

3.2.7 LCD REMOTE Annunciator

Locate the LCD annunciator as shown on the drawings. Mount the annunciator, with the top 6 feet above the finished floor or center the annunciator at 5 feet, whichever is lower.

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.
- 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. All wiring shall be identified by permanent circuit label tags with the circuit identifier listed. The Basis of Design is 3M Scotchcode wire marker.
- 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.
- g. For Class "A" circuits with conductor lengths of 10 feet or less, the conductors must be permitted to be installed in the same raceway in accordance with NFPA 72.

3.3.5 Conductor Terminations

Labeling of conductors at terminal blocks in terminal cabinets, 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 CONNECTION OF NEW SYSTEM

The following new system connections must be made during the last phase of construction, at the beginning of the pre-Government tests. New system connections must include:

- a. Connection of new system transmitter to existing installation fire reporting system.

Once these connections are made, system must be left energized. Report immediately to the Contracting Officer, coordination and field problems resulting from the connection of the above components.

3.5 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.

3.6 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.

3.7 FIELD QUALITY CONTROL

3.7.1 Test Procedures

Submit detailed test procedures, prepared and signed by the NICET Level III, 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.

3.7.2 Pre-Government Testing

3.7.2.1 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.

3.7.2.2 Request for Government Final Test

When the verification of compliant installation has been completed, submit a formal request for Government final test to the Contracting Officer's Representative (COR). 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.

3.7.3 Correction of Deficiencies

If equipment was found to be defective or non-compliant with contract requirements, perform corrective actions and repeat the tests. Tests must be conducted and repeated if necessary until the system has been demonstrated to comply with all contract requirements.

3.7.4 Government Final Tests

The tests must be performed in accordance with the approved test procedures in the presence of the DFPE. Furnish instruments and personnel required for the tests. The following must be provided at the job site for Government Final Testing:

- a. The manufacturer's technical representative.
- b. The contractor's Qualified Fire Protection Engineer (QFPE).
- c. Marked-up red line drawings of the system as actually installed.
- 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, 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.

3.8 MINIMUM SYSTEM TESTS

3.8.1 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".

3.8.2 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.

3.8.3 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.

3.9 SYSTEM ACCEPTANCE

Following acceptance of the system, as-built drawings and O&M manuals must be delivered to the Contracting Officer for review and acceptance. 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, DXF 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.

3.10 INSTRUCTION OF GOVERNMENT EMPLOYEES

3.10.1 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.

3.10.2 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.

3.10.3 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.

3.11 EXTRA MATERIALS

3.11.1 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.

3.11.2 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.

3.11.3 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 --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 31 - EARTHWORK

SECTION 31 00 00

EARTHWORK

08/08, CHG 2: 02/21

PART 1 GENERAL

- 1.1 CRITERIA FOR BIDDING
- 1.2 REFERENCES
- 1.3 DEFINITIONS
 - 1.3.1 Satisfactory Materials
 - 1.3.2 Unsatisfactory Materials
 - 1.3.3 Cohesionless and Cohesive Materials
 - 1.3.4 Degree of Compaction
 - 1.3.5 Topsoil
 - 1.3.6 Unstable Material
 - 1.3.7 Select Material
 - 1.3.7.1 General Requirements
 - 1.3.8 Expansive Soils
 - 1.3.9 Pile Supported Structure
- 1.4 SYSTEM DESCRIPTION
 - 1.4.1 Classification of Excavation
 - 1.4.1.1 Common Excavation
 - 1.4.2 Dewatering Work Plan
- 1.5 SUBMITTALS

PART 2 PRODUCTS

- 2.1 REQUIREMENTS FOR OFFSITE SOILS
- 2.2 BURIED WARNING AND IDENTIFICATION TAPE
 - 2.2.1 Warning Tape for Metallic Piping
 - 2.2.2 Detectable Warning Tape for Non-Metallic Piping
- 2.3 MATERIAL FOR RIP-RAP
 - 2.3.1 Bedding Material
 - 2.3.2 Grout

PART 3 EXECUTION

- 3.1 STRIPPING OF TOPSOIL
- 3.2 GENERAL EXCAVATION
 - 3.2.1 Ditches, Gutters, and Channel Changes
 - 3.2.2 Drainage Structures
 - 3.2.3 Drainage
 - 3.2.4 Trench Excavation Requirements
 - 3.2.4.1 Bottom Preparation
 - 3.2.4.2 Removal of Unyielding Material
 - 3.2.4.3 Removal of Unstable Material
 - 3.2.4.4 Excavation for Appurtenances
 - 3.2.5 Underground Utilities
 - 3.2.6 Structural Excavation
- 3.3 SELECTION OF BORROW MATERIAL

- 3.4 SHORING
 - 3.4.1 General Requirements
 - 3.4.2 Geotechnical Engineer
- 3.5 GRADING AREAS
- 3.6 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE
- 3.7 GROUND SURFACE PREPARATION
 - 3.7.1 General Requirements
 - 3.7.2 Frozen Material
- 3.8 UTILIZATION OF EXCAVATED MATERIALS
- 3.9 BURIED TAPE AND DETECTION WIRE
 - 3.9.1 Buried Warning and Identification Tape
- 3.10 FILLING, BACKFILLING AND COMPACTION
 - 3.10.1 Trench Backfill
 - 3.10.1.1 Replacement of Unyielding Material
 - 3.10.1.2 Replacement of Unstable Material
 - 3.10.1.3 Bedding and Initial Backfill
 - 3.10.1.3.1 Class I
 - 3.10.1.3.2 Class II
 - 3.10.1.3.3 Sand
 - 3.10.1.3.4 Gravel and Crushed Stone
 - 3.10.1.4 Final Backfill
 - 3.10.1.4.1 Roadways
 - 3.10.1.4.2 Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas
 - 3.10.2 Backfill for Appurtenances
- 3.11 SPECIAL REQUIREMENTS
 - 3.11.1 Gas Distribution
 - 3.11.2 Water Lines
 - 3.11.3 Heat Distribution System
 - 3.11.4 Electrical Distribution System
 - 3.11.5 Rip-Rap Construction
 - 3.11.5.1 Bedding Placement
 - 3.11.5.2 Stone Placement
- 3.12 EMBANKMENTS
 - 3.12.1 Earth Embankments
- 3.13 SUBGRADE PREPARATION
 - 3.13.1 Proof Rolling
 - 3.13.2 Construction
 - 3.13.3 Compaction
 - 3.13.3.1 Subgrade for Pavements
- 3.14 FINISHING
 - 3.14.1 Subgrade and Embankments
 - 3.14.2 Grading Around Structures
- 3.15 TESTING
 - 3.15.1 Fill and Backfill Material Gradation
 - 3.15.2 In-Place Densities
 - 3.15.3 Check Tests on In-Place Densities
 - 3.15.4 Moisture Contents
 - 3.15.5 Optimum Moisture and Laboratory Maximum Density
 - 3.15.6 Tolerance Tests for Subgrades
 - 3.15.7 Displacement of Sewers
- 3.16 DISPOSITION OF SURPLUS AND RACS MATERIAL

-- End of Section Table of Contents --

SECTION 31 00 00

EARTHWORK

08/08, CHG 2: 02/21

PART 1 GENERAL

1.1 CRITERIA FOR BIDDING

Base bids on the following criteria:

- a. Surface elevations are as indicated.
- b. Pipes or other artificial obstructions, except those indicated, will not be encountered.
- c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.
- d. Material character is indicated by the boring logs.

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 WATER WORKS ASSOCIATION (AWWA)

AWWA C600 (2017) Installation of Ductile-Iron Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C136/C136M (2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D698 (2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

ASTM D1140 (2017) Standard Test Methods for Determining the Amount of Material Finer than 75- μ m (No. 200) Sieve in Soils by Washing

ASTM D1556/D1556M (2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

ASTM D2487 (2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification

System)

ASTM D4318 (2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D6938 (2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1 (2014) 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

1.3 DEFINITIONS

1.3.1 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, SC, CL,. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements which comprise stones less than 3 inches in any dimension.

1.3.2 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; RACS (Regulated Asbestos Containing Soils); and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the Contracting Officer when encountering any contaminated materials.

1.3.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM 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. Cohesionless materials placed under pavements or building slabs must be drained to a drainage system or daylighted for surface drainage.

1.3.4 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 D698 abbreviated as a percent of laboratory maximum density.

1.3.5 Topsoil

Material suitable for topsoils obtained from offsite areas and/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. Amend topsoil pH range to obtain a pH of 5.5 to 7.

1.3.6 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.3.7 Select Material

1.3.7.1 General Requirements

Imported clay material consists of materials classified as CL by ASTM D2487 where indicated. The liquid limit of such material must not exceed 30 percent when tested in accordance with ASTM D4318. The plasticity index must not be greater than 15 percent when tested in accordance with ASTM D4318, and not less than 50 percent by weight must be finer than No. 200 sieve when tested in accordance with ASTM D1140. Imported clay materials must have a maximum expansive potential of 1.0% when measured on a sample compacted to 95% of the ASTM D698 maximum dry density at optimum moisture content and when confined under a 200 psf surcharge and submerged in water.

Imported fill that meets the requirements of CDOT Class I Structural Fill as stated in Section 703 of the CDOT 2019 Standards and Specifications can be considered acceptable for use as engineered fill in exterior flatwork and pavement areas, provided the subgrade is graded to drain. Granular soils should not be used as engineered fill below buildings, slabs or pavement areas unless they are properly drained to a drainage system or day-lit such that water cannot pool below any project elements.

1.3.8 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 15 when tested in accordance with ASTM D4318 and have a maximum expansive potential of greater than 1.0% when measured on a sample compacted to 95% of the ASTM D698 maximum dry density at optimum moisture content and when confined under a 200 psf surcharge and submerged in water.

1.3.9 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.4 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.

1.4.1 Classification of Excavation

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.4.1.1 Common Excavation

Include common excavation with the satisfactory removal and disposal of all materials not classified as rock excavation.

1.4.2 Dewatering Work Plan

Submit procedures for accomplishing dewatering work.

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:

SD-01 Preconstruction Submittals

Shoring; G

Dewatering Work Plan; G

SD-03 Product Data

Utilization of Excavated Materials; G

SD-06 Test Reports

Testing

Borrow Site Testing

Within 24 hours of conclusion of physical tests, submit 7 copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing

Non-Hazardous Waste shipping manifest

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 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
Yellow	Gas, Oil; Dangerous Materials
Orange	Telephone and Other Communications
Blue	Water Systems
Green	Sewer Systems

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 MATERIAL FOR RIP-RAP

Provide rock conforming to CDOT Standard Specifications Section 506.

2.3.1 Bedding Material

Provide bedding material per CDOT Standard Specifications Section 703.08 (b).

2.3.2 Grout

Provide durable grout per CDOT Standard Specifications Section 507.05.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 2 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. Stockpile in locations indicated 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 other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on the drawings. Do not excavate ditches and gutters below grades shown. Backfill the excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits 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 other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.3 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.

3.2.4 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.

3.2.4.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Scarify 12" below the bottom of the utility or bedding material, moisture condition and compact or replace with non-expansive imported fill. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones of 2 inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, to avoid point bearing.

3.2.4.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, remove such material 12 inch below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.4.3 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 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.

3.2.4.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures sufficient to leave at least 12 inches clear between the outer structure surfaces and the face of the excavation or support members. 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.

3.2.5 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within 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.

3.2.6 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. Do not obtain borrow within the limits of the project site.

3.4 SHORING

3.4.1 General Requirements

Submit a Shoring and Sheet piling 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 sheet piling of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheet piling as excavations are backfilled, in a manner to prevent caving.

3.4.2 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheet piling and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and Contracting Officer of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The Contracting Officer is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

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 and unsatisfactory 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 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. Only use excavation methods that will leave the foundation rock in a solid and unshattered condition. Roughen the level surfaces, and cut the sloped surfaces, as indicated, into rough steps or benches to provide a satisfactory bond. Protect shales from slaking and all surfaces from erosion resulting from ponding or water flow.

3.7 GROUND SURFACE PREPARATION

3.7.1 General Requirements

Regulated Asbestos Contaminated Soils (RACS) may be present. A Certified Asbestos Building Inspector (CABI) must be present at all times during earthwork operations. Follow all provisions of the Buckley Space Force Base Specified Regulated Asbestos Contaminated Soil Management Plan (MMP) Dated March 2016. Remove any RACS discovered per the direction of the CABI and dispose of off base at an approved facility per all local, state, and federal guidelines. For all asbestos sent off base, a Non-Hazardous Waste shipping manifest must be prepared and must include the Buckley EPA ID number (CO9570025644) and must be signed by the generator, transporter, and facility owner. Remove and replace unsatisfactory material with satisfactory materials, as directed by the Contracting Officer, in surfaces to receive fill or in excavated areas. Beneath pavement and flatwork, scarify the excavated or natural ground portion to a depth of 12 inches and compact it as specified for the adjacent fill.

3.7.2 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.

3.8 UTILIZATION OF EXCAVATED MATERIALS

Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, 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.

3.9 BURIED TAPE AND DETECTION WIRE

3.9.1 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.

3.10 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 95 percent of laboratory maximum density for cohesive materials or 98 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 +1 to +4 of the optimum moisture content with an average daily moisture content of +2 below the proposed building for cohesive materials, within range of 0 to +3 of the optimum moisture content below pavements and flatwork for cohesive materials, and within range of -2 to +2 of the optimum moisture content for cohesionless materials.

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.

3.10.1 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 complete the backfill of the trench until all specified tests are performed.

A clay "trench plug" that extends at least 10 feet out from the building exterior must be constructed for all utility trenches that penetrate beneath the building. The clay trench plug material must consist of approved clay materials compacted in accordance with these Specifications. The clay trench plug must completely surround the utility line and be properly placed and compacted in accordance with these Specifications.

3.10.1.1 Replacement of Unyielding Material

Replace unyielding material removed from the bottom of the trench with select granular material or initial backfill material.

3.10.1.2 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.

3.10.1.3 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:

3.10.1.3.1 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.

3.10.1.3.2 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.

3.10.1.3.3 Sand

Clean, coarse-grained sand classified as SW or SP by ASTM D2487 for bedding as indicated.

3.10.1.3.4 Gravel and Crushed Stone

Clean, coarsely graded natural gravel, crushed stone or a combination thereof having a classification of GW GP in accordance with ASTM D2487 for bedding and backfill as indicated. Do not exceed maximum particle size of 3 inches.

3.10.1.4 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, with satisfactory material. Place backfill material and compact as follows:

3.10.1.4.1 Roadways

Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.

3.10.1.4.2 Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas

Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 95 percent maximum density. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.10.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed, 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.

3.11 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.11.1 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.

3.11.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 4.5 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.11.3 Heat Distribution System

Free initial backfill material of stones larger than 1/4 inch in any dimension.

3.11.4 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.

3.11.5 Rip-Rap Construction

Construct rip-rap in accordance with CDOT Standard, paragraph 506 in the areas indicated. Trim and dress indicated areas to conform to cross sections, lines and grades shown within a tolerance of 0.1 foot.

3.11.5.1 Bedding Placement

Spread bedding material uniformly to a thickness of at least 3 inches on prepared subgrade as indicated. Finish bedding to present even surface free from mounds and windrows.

3.11.5.2 Stone Placement

Place rock for rip-rap on prepared bedding material to produce a well graded mass with the minimum practicable percentage of voids in conformance with lines and grades indicated. Distribute larger rock fragments, with dimensions extending the full depth of the rip-rap throughout the entire mass and eliminate "pockets" of small rock fragments. Rearrange individual pieces by mechanical equipment or by hand as necessary to obtain the distribution of fragment sizes specified above.

3.12 EMBANKMENTS

3.12.1 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 to at least 95 percent laboratory maximum density for cohesive materials or 98 percent laboratory maximum density for cohesionless materials. Backfill and fill material must be within range of +1 to +4 of the optimum moisture content with an average daily moisture content of +2 below the proposed building for cohesive materials, within range of 0 to +3 of the optimum moisture content below pavements and flatwork for cohesive materials, and within range of -2 to +2 of the optimum moisture content for cohesionless materials.

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.

3.13 SUBGRADE PREPARATION

3.13.1 Proof Rolling

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. After stripping, proof roll the existing subgrade 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 select material.

3.13.2 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. Excavate rock encountered in the cut section to a depth of 6 inches below finished grade for the subgrade. 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.

3.13.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 90 percent of laboratory maximum density.

3.13.3.1 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown.

3.14 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.

3.14.1 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.

3.14.2 Grading Around Structures

Construct areas within 10 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.

3.15 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 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 500 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 2,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.
- b. One test per 2,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.
- c. One test per 2,000 square feet, or fraction thereof, of each lift of embankment or backfill for parking areas.

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 check test per lift for each 10,000 square feet, or fraction thereof, of each lift of fill or backfill compacted by other than hand-operated machines.
- b. One check test per lift for each 10,000 square feet, of fill or backfill areas compacted by hand-operated machines.
- c. One check test per lift for each 5,000 square feet, or fraction thereof, of embankment or backfill for parking areas.

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 per 500 cubic yards of fill and backfill, or 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 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.

3.16 DISPOSITION OF SURPLUS AND RACS 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.

RACS must be disposed of off of government property per the MMP.

-- End of Section --

This page was intentionally left blank for duplex printing.

BAFB SPECIFIC REGULATED ASBESTOS CONTAMINATED SOIL MANAGEMENT PLAN BUCKLEY AIR FORCE BASE, COLORADO



Buckley Air Force Base
460th Civil Engineer Squadron
660 South Aspen Street, Stop 86
Buckley Air Force Base, Colorado 80011-9564

March 2016

FINAL

Prepared by:
460th Civil Engineer Squadron
Installation Management Flight, Environmental Element (460 CES/CEIE)
660 South Aspen Street, Stop 86
Buckley Air Force Base, Colorado 80011-9564

This Page Intentionally Left Blank

TABLE OF CONTENTS

Acronyms

1. INTRODUCTION

- 1.1 Plan's Purpose
- 1.2 BAFB Background Information

2. PROPERTY LOCATION

3. GENERAL SITE DESCRIPTION

- 3.1 Conceptual Model of Regulated Asbestos Containing Soils (RACS) on Buckley AFB (BAFB).
- 3.2 Known Regulated Asbestos-Containing Soils Areas
- 3.3 Former Facilities Areas (FFA)
- 3.4 Areas Not Presently Known or Suspected to be Impacted by RACS

4. SOIL CHARACTERIZATION

5. BAFB MANAGEMENT OF REGULATED ASBESTOS CONTAMINATED SOIL (RACS)

- 5.1 Planned Projects
- 5.2 Emergency/Off-Duty Hours Coordination process for Work Clearance
- 5.3 AF Form 103 Process
- 5.4 Points of Contact
- 5.5 Management of Regulated Asbestos-Contaminated Soils (RACS)

6. CITED REFERENCES

APPENDICES

- A: 6 CCR 1007-2, Part 1 sections 1.1, 1.2, and 1.3
- B: Figure A-1
- C: List of Suspect Asbestos Containing Building Materials
- D: CDPHE Notification Forms
- E: 6 CCR 1007-2, Part 1 sections 5 Appendix 5A
- F: Squadron Duty Officer (SDO) and On-Call Craftsman Policy Letter
- G: AF Form 103

This Page Intentionally Left Blank

ACRONYMS

460 CES/CEIE Buckley Air Force Base Environmental Element

AC	Abatement Contractor
ACM	Asbestos-Containing Material(s)
AMS	Colorado-certified Air Monitoring Specialist
AOC	Area of Contamination
BAFB	Buckley Air Force Base
CABI	Colorado-Certified Asbestos Building Inspector
CBR	Cannot be Read
CCR	Code of Colorado Regulations
CDPHE	Colorado Department of Public Health and the Environment
DOF	Depth of Find
EOF	Extent of Find
ECP	Emission Control Plan
EL	Excursion Limit
EM	Electromagnetic
EPA	Environmental Protection Agency
f/cc	fibers per cubic centimeter
FFA	Former Facility Areas
GC	General Contractor
GPR	Ground Penetrating Radar
HEPA	High Efficiency Particulate Air
IDP	Installation Development Plan
IDW	Investigative Derived Waste
IRP	Installation Restoration Program
MCE	Mixed Cellulose Ester
mm	millimeter
mph	miles per hour
NA	Not Analyzed
NIOSH	National Institute of Occupational Safety and Health
Non-RACS	Non-Regulated Asbestos Contaminated Soil
NVLAP	National Voluntary Laboratory Accreditation Program
OSHA	Occupational Safety and Health Administration
PAT	Proficiency Analytical Testing
PCM	Phase Contrast Microscopy
PLM	Polarized Light Microscopy
PPE	Personal protective equipment

QPM	Qualified Project Manager
RACS	Regulated Asbestos Contaminated Soil
RWA	Regulated Work Area
SCMP	Soil Characterization and Management Plan
S/ACM	Suspect ACM
SOP	Standard Operating Procedure
TEM	Transmission Electron Microscopy
UNCC	Utility Notification Center of Colorado
WQCC	Water Quality Control Commission
µg	micrograms

1. INTRODUCTION

1.1 Plan's Purpose: The purpose of the Buckley Air Force Base (BAFB) Specific Regulated Asbestos Contaminated Management Plan (BSRMP) is to put in place guidance and procedures to meet all regulatory requirements associated with Regulated Asbestos Contaminated Soil (RACS) on BAFB's real property. This plan is a working document subject to revision and future changes based on regulatory requirements and/or site conditions.

1.2 BAFB Background Information

The BSRMP replaces the 2013 Soil Characterization and Management Plan (SCMP) for BAFB. On 19 August 2014 the Colorado Department of Health and the Environment (CDPHE – “Department”) amended Regulations Pertaining to Solid Waste Sites and Facilities, 6 CCR 1007-2 Part 1 (the “Regulations”), becoming effective 30 September 2014. The amendment was primarily on Sections 1.1, 1.2, 1.3 (Appendix A) and 5.5 of the Regulations (Refer to section 5.5 of this plan). Section 5.5 specifically addresses the management of RACS. Therefore, the 2013 BAFB SCMP needed to be renamed and revised to incorporate current regulation requirements.

Through previous surveys/investigations, excavations and remediation actions conducted at BAFB, it has been determined that in certain areas of the installation debris is present, some of which has ACMs subject to requirements in 6 CCR 1007-2 Part-1. These ACMs are typically associated with demolition of structures built since the installation was established in 1938. A significant amount of construction occurred during WWII. Military construction often included fire resistant elements that contained asbestos in addition to standard construction materials that contained asbestos. Past demolition methods included minimal or no segregation of building materials. The construction debris from structural demolition would have been deposited on the surface of the site and/or within a thin horizontal layer either at the surface or just below it where the demolition occurred. The debris and any associated ACMs would not migrate through the soils. Most construction debris would have been sent off the installation for disposal or to an on installation landfill. The Installation Restoration Program (IRP) has identified construction waste landfills on BAFB. Based on this information, a site model was developed in 2009 by using historic aerial photographs to establish building footprints for structures present in the past. These were identified as Former Facility Areas (FFA).

2. PROPERTY LOCATION

BAFB is located in Aurora, Colorado and occupies 3,540 acres. It is home to the 460th Space Wing and hosts 88 tenants and/partners representing every branch of service, including the Navy, Marine, Army and Air Force. Selected National Guard and Reserve units from each branch, as well as selected United States Coast Guard components, also maintain operations at BAFB.

More than 13,800 military and civilian employees, including contract, full-time, and part-time employees work and/or live on the installation. The base occupies approximately 3,235 acres and includes active runways, privatized military family housing, and military essentials.

3. GENERAL SITE DESCRIPTION

BAFB consists of both developed and undeveloped land. Undeveloped land is typically covered with native vegetation of grasses and small shrubs. The closest population center is located west of BAFB in the City of Aurora, Colorado. Land use adjacent to the base is industrial and agricultural to the north, commercial and residential to the west, residential and agricultural to the south, and agricultural to the east.

3.1 Conceptual Model of Regulated Asbestos Containing Soils on BAFB

In 2009, a site model map was created illustrating areas on BAFB that may contain have contained construction debris and ACM. Historical photographs were used to approximate the number and location of former buildings that may have contained ACM. At various points in time, these buildings were removed from BAFB or were demolished in place and buried. In order to err on the side of caution, though, the whole area on which these buildings were located was treated as areas of S/ACM

Since 2009, a significant portion of these areas have been altered and remediated due to the excavation of soils and the development of land. Such excavations and development were performed after properly implementing the National Environmental Policy Act (NEPA) requirements through the AF Environmental Impact Analysis Process (EIAP) to evaluate the environmental effects of proposed actions. Through the EIAP process, environmental assessments were performed and sampling was performed (Ref Section 6 Items d – h). Such excavation and development resulted in the removal of all RACS within the construction site, and in some cases, the import of new soil onto BAFB (Ref Section 6 Items i – n). Given this, a review of this site model map was performed in 2015 to accurately reflect those areas where ACM may still be located on BAFB.

These revised known RACS (Section 3.2)--and FFA (Section 3.3) are shown in attached Figure A-1 (Appendix B). This is included in the base Installation Development Plan (IDP, Ref Section 6 Item o) as sites having associated land use restrictions. In order to address those situations in which asbestos may be encountered, and in an attempt to reduce delays in planned construction projects, BAFB developed this BSRMP incorporating the Standard Requirements for the Disturbance of RACS from Section 5.5.7 6 CCR 1007-2. Upon plan approval by Colorado Department of Public Health and the Environment (CDPHE), no additional soil management plans will be required as it meets the requirement in Section 5.5.5(A) of 6 CCR 1007-2.

Although it is frequently difficult to distinguish between specific types of ACM without specific associated building components, the types of ACM found at varying locations on BAFB typically include thermal system insulation, transite, and flooring material (linoleum, floor tile, etc.). This is consistent with construction practices and building materials in use for military and industrial buildings. Past demolition activities typically did not segregate ACM from other building materials. In 2005, an asbestos inspection contractor provided BAFB a list of suspect asbestos containing building materials (Appendix C). The list is not BAFB specific, therefore construction debris will need to be evaluated in accordance with the regulations to determine if RACS is present.

3.2 Known Regulated Asbestos-Containing Soils Areas

The two areas presently known to be impacted by asbestos debris and/or asbestos-containing soils are noted on Figure A-1. Both of these areas have been capped with clean soil. The area located on the northwest portion of BAFB, was capped as part of Compliance Order (CO) Number 03-09-30-01 dated 30 Sep 2003. The CO included the removal of asbestos contaminated soil stockpiles generated during the construction of buildings 1 and 35. The Soil Stockpile Removal Report (ref Section 6 Item i) included site restoration actions after stockpiles were removed. This includes approximately 2,500 yd³ of clean soil fill, soil amendments and native seeding to the soil surface. The report was accepted by CDPHE by letter dated 31 Jul 2007 (Ref Section 6 Item j). However, within the same letter, the CDPHE noted there are still “potential asbestos contaminated soils.... below the surface. Accordingly, all future sub-surface soil disturbing activities in the areas subject to this plan shall be conducted in accordance with Colorado Solid Waste Regulations and applicable law.” The CO was officially closed by the CDPHE on 16 Mar 2011 upon conditional approval of the SCMP.

The second area is located in a southern portion of BAFB. This area is currently under the BAFB’s IRP as Site 3. Site 3 is a closed landfill managed under the IRP. Any excavation within these areas will require specific pre-project coordination with BAFB Air Force Civil Engineer Center (AFCEC) Restoration Program Manager, the Environmental Protection Agency (EPA), and CDPHE; and such work will be addressed under a separate plan.

RACS is composed of friable ACM and non-friable ACM, with a high probability of releasing fibers when subjected to mechanical forces or as a result of a deteriorated state, may be considered RACS. Specific project owner or owner representative shall notify CDPHE at least 10 working days prior to conducting soil-disturbing activities in areas of known RACS. The notification will be submitted to CDPHE by using the 10-Day Notification Form in Appendix D (ref Par 5.5.5 of Regulations and this plan).

3.3 Former Facilities Areas

The Air Force acknowledges that there is an increased risk of discovering asbestos debris and/or asbestos-containing soil in areas where former facilities were located. A number of Former Facility Areas have been redeveloped and are currently considered Areas Not Presently Known or Suspected to be impacted by Asbestos Debris or Asbestos Containing Soils. These were determined via reviews of archives containing past environmental assessments, construction/soil construction schematics, hazardous waste manifests, soil characterizations plans, and aerial photographs.

For the purpose of this plan, FFA areas identified on Figure A-1 are those that there has been limited or no re-development since the former facilities were demolished/removed. The original structures may have contained ACM and/or demolition process is unknown/undocumented. During the AF103 (Ref Section 5.3) process the proponent will be notified that the work will occur within a FFA and there any debris encountered must be properly evaluated. If visible debris is discovered during work in one of the these FFA, all work will be stopped and, as required by the regulations, either a Qualified Project Manager (QPM) or a Colorado-certified Asbestos Building Inspector (CABI) will make a RACS determination. The QPM will determine

if additional evaluation and sampling is required by a CABI. If CABI determines the debris to be RACS the notification process discussed in Section 3.1 will be implemented.

Upon confirmation of the presence of asbestos, measures will be taken to establish a Regulated Work Area (RWA) as described in Section 5.5 of this document to prevent site access by unauthorized persons and minimize the risk of asbestos exposure to the general public; and surface soil stabilization measures, such as covering with tarps or dust suppressant, will be implemented. The soils shall be managed as RACS in accordance with Section 5.5.

3.4 Areas Not Presently Known or Suspected to be Impacted by Asbestos Debris or Asbestos-Containing Soils

No additional evaluation is required in areas presently not suspected to be impacted by asbestos debris or RACS prior to beginning soil-disturbing activities. However, if any construction debris is encountered, soil-disturbing activities will cease and the site will be re-evaluated through an inspection by either a QPM or CABI. Notification to CDPHE will be submitted within 24 hours of discovery using the 24 hour Notification of Unplanned Asbestos Discovery in Appendix D. If RACS are identified, activities will be implemented in accordance with the regulations and this plan.

4. SOIL CHARACTERIZATION

Soil Characterization will comply with Appendix 5A of Section 5 included in Appendix E.

5. BAFB MANAGEMENT OF RACS

5.1 Projects: If a project has been sited on RACS areas during the Environmental Impact Analysis Process (EIAP), the proponent will be required to abide by the requirements of Section 5.5 of the regulations and this plan. The BAFB Asbestos Program Manager will review project documents (e.g. design drawings, statements of work, project specifications, etc.) to ensure management of RACS is addressed. This will include the submittal of RACS management compliance documentation (e.g. sampling reports, training certifications, disposal manifests, etc.) to 460 CES/CEIE for review and approval.

5.2 Emergency/Off-duty Hours Coordination Process for Work Clearance: The Squadron Duty Officer (SDO) and On-Call Policy memo (Appendix F Par 4.h.6) outlines coordination procedures for AF Form 103, Base Civil Engineering Work Clearance Request (Appendix F). In the case of work required on RACS or suspect RACS area, the requester will be responsible to follow procedures in par 5.5.4 of the regulations and this plan.

5.3. AF Form 103 Process: An AF Form 103 is required for commencement of work (planned or unplanned). The process includes requester signing Environmental Acknowledgement statement (Appendix G, Page 2, Para 5). This statement requires proponents/requesters to comply with all environmental regulations and procedures during performance of work. In instances where the work is in within identified RACS or Suspect RACS areas, measures will be taken to ensure disturbances of the soils are in accordance with both regulations and this plan. Authority to approve AF 103 falls with the 460 CES Chief of Operations and/or Deputy Chief of

Operations (460 CES/CEO).

5.4 Points of Contact: The following personnel are BAFB primary points of contact for the implementation of BSRMP:

NAME	TITLE	OFFICE SYMBOL	PHONE
Martin Burris	BAFB Asbestos Program Manager	460 CES/CEIE	720-847-5723
Celiann Gonzalez	Environmental Element Chief	460 CES/CEIE	720-847-7245
Maj Birju Patel	Chief of Operations	460 CES/CEO	720-847-6721
Bob Powers	Deputy Chief, Operations	460 CES/CEO	720-847-9275
Scott Wilson	Restoration Program Manager	AFCEC	720-847-7159
Thomas Hoeflinger	BAFB Attorney-Advisor	460 SW/JA	720-847-6982

5.5 MANAGEMENT OF REGULATED ASBESTOS-CONTAMINATED SOIL (RACS):

Note: In order to maintain consistency between BSRMP and CDPHE regulations, a copy of Section 5.5 of CDPHE amended Regulations Pertaining to Solid Waste Sites and Facilities, 6 CCR 1007-2 Part 1 Section 5.5 is included below. For the purposes of this plan, the owner is the 460th Space Wing. Operators are those performing or requesting work in these areas.

5.5.1 SCOPE AND APPLICABILITY: The requirements of Section 5.5 apply to the owner or operator of any property with regulated asbestos contaminated soil (RACS) at which soil- disturbing activities are occurring or planned. The owner/operator may choose to follow the procedures set forth in Sections 5.5.1(A) and 5.5.1(B) below when debris is exposed or disturbed to determine if the debris is RACS. The requirements of Sections 5.5.1(C) and 5.5.1(D) apply when RACS is exposed or disturbed.

(A) Any person who disturbs debris or exposes debris during a soil disturbing activity shall characterize debris to determine the applicability of Section 5.5, and have appropriate personnel to characterize debris. Any person who disturbs debris or exposes debris during a soil disturbing activity shall:

(1) Conduct visual inspection of disturbed material;

(2) If debris is exposed during soil disturbing activities, and/or the soil or ash is known to contain asbestos fibers, through documented evidence, then Section 5.5 is applicable.

If there is no visible RACS or documented evidence of RACS at a site, an owner/operator does not have a duty under the Regulations to sample or otherwise investigate for RACS prior to commencing soil disturbing activities;

(3) If debris is exposed that only contains green waste, and/or natural stone with no associated material suspected of containing asbestos fibers, then Section 5.5 is not applicable.

(4) In the event of an emergency in which a soil disturbing activity in an area of debris must continue or commence at once, a RACS determination in accordance with Section 5.5.1(B) may be postponed during the initial response to the immediate emergency. However, the RACS determination must be made within 48 hours of the initial emergency response.

(5) Any person who exposes but does not disturb debris during a soil disturbing activity shall have protocols to characterize debris as required by this Section 5.5.1(A) and stabilize any debris determined to be RACS as required by Section 5.5.7(K), unless the debris is exempted by subsection 5.5.2(A) through (F).

(B) Any person who disturbs debris during soil disturbing activities, when the subject debris is not excluded within Section 5.5.1(A)(3), must inspect the debris, through continuous visual inspection during soil disturbing activities, to determine if the debris is, or contains, suspect asbestos-containing material (ACM). If debris is exposed that only contains metal, glass, plastic, wood, and/or bare concrete with no associated material suspected of being ACM (such as sealants, adhesives, mastics, coatings, adhered materials, or resins), then Section 5.5 is not applicable. The person(s) conducting the visual inspection must be a Qualified Project Monitor (QPM) or a Certified Asbestos Building Inspector (CABI).

All suspect ACM(s) must be:

(1) Assumed to be ACM; or

(2) Sampled by a CABI. The samples shall be analyzed by a National Voluntary Laboratory Accreditation Program (NVLAP) participating laboratory utilizing Polarized Light Microscopy (PLM) (EPA Method 600/R-93/116 or equivalent) to determine if it is ACM; or

(3) Determined to be ACM, or non-ACM, through the use of documentation specific to the material observed in the field establishing the asbestos content of the material (e.g. laboratory analysis results from previous encounters with the same material).

(4) The ACM determination shall be made within seven (7) calendar days of discovery of the debris.

(a) Within 24 hours of discovery of debris, and until the ACM determination is made, the debris shall be stabilized in accordance with Section 5.5.4(A)(3) of the Regulations and this plan.

(b) No additional disturbance, other than necessary to perform the required stabilization in Section 5.5.4(A)(3), of the debris shall occur prior to the asbestos determination.

(5) A person who disturbs debris, determined or assumed to be or contain ACM per this 5.5.1(B), shall determine if the ACM is exempted in accordance with Section 5.5.2 of the Regulations and this plan.

(6) A person who disturbs debris, determined or assumed to be or contain ACM per this 5.5.1(B), shall make a RACS determination by:

(a) Assuming the debris containing ACM is RACS and managing the RACS in accordance with Section 5.5 of Regulations and this plan; or

(b) Applying site and material specific knowledge of the presence or absence of RACS based on observation and/or documented evidence about the nature of ACM(s).

(7) The owner/operator shall retain, or make available for inspection, records of all RACS determinations onsite for the duration of the debris disturbance, which shall be retained by the owner/operator for a period of six (6) months after the completion of debris disturbing activities.

(C) Soil or ash known to contain non-visible asbestos, based on documented evidence, is RACS and if exposed or disturbed shall be managed in accordance with Regulations and this plan.

(D) If soil, ash, or debris is, or contains, RACS then:

(1) RACS that is exposed or disturbed shall be managed, disposed of, or reused in accordance with Regulations and this plan.

(2) Removal of ACM that is on, or comprises, a facility component, that is located on or in soil that will be disturbed, shall be conducted under this Section 5.5, in accordance with work practices in Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B), Section III.V, and is not subject to the permit requirements of 5 CCR 1001-10, Part B, if the total quantity of ACM is below the following trigger levels:

(a) 260 linear feet on pipes; or

(b) 160 square feet on other surfaces; or

(c) The volume of a 55-gallon drum.

(3) RACS that is generated and not disposed of or reused in compliance with Section 5.5.8 of Regulations and this plan is solid waste and shall be managed in accordance with the landfill requirements of the Colorado Solid Wastes Disposal Sites and Facilities Act (C.R.S. 30-20, Part 1) and Sections 5.1 through 5.4 of the Regulations.

(4) Except as provided in Section 5.5.1(D)(5), a person who disturbs or exposes RACS shall make the decision upon the initial discovery of RACS to either manage the RACS in accordance with Section 5.5, or cease soil disturbing activities and permanently stabilize the disturbed or exposed RACS to control the release of asbestos fibers in accordance with one of

the following:

- (a) Cover RACS with geofabric, or equivalent visible and physical barrier, and restore the site to pre-disturbance conditions using fill suitable for unrestricted use; or
- (b) Cover RACS with geofabric, or other visible and physical barrier, followed by eighteen (18) inches of fill suitable for unrestricted use, and vegetation; or
- (c) Cover RACS with geofabric, or other visible and physical barrier, followed by six (6) inches of fill suitable for unrestricted use, and concrete or asphalt; or
- (d) Cover RACS with geofabric, or other visible and physical barrier, followed by fill suitable for unrestricted use to grade for vertical excavation faces or trenches; or
- (e) Alternate cover designs as approved by the Department.

(5) RACS that is driven upon is an RWA and shall be kept adequately wet in order to prevent visible emissions from leaving the RWA, or demonstrate that asbestos is not leaving the RWA above risk based thresholds. All equipment surfaces that have come into contact with RACS shall be decontaminated per Section 5.5.7(I) before leaving the RWA.

5.5.2 EXEMPTIONS

(A) Removal of ACM on a facility component with asbestos quantities above the trigger levels, as defined in 5.5.1(D)(2), is subject to the permit and abatement requirements of Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B), and is therefore not subject to this Section 5.5., but shall still comply with Sections 5.1 through 5.4 of the Regulations.

(B) Spill response activities that are subject to the requirements of Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B) are not subject to the requirements of Section 5.5, but shall still comply with Sections 5.1 through 5.4 of the Regulations.

(C) Ambient occurrences of asbestos fibers in soil that are demonstrated to be the result of background conditions and not the result of site specific activities are not subject to the requirements of this Section 5.5. This background demonstration shall be submitted to, and approved by, the Department prior to the exemption being exercised.

(D) During active solid waste disposal operations, asbestos waste disposal areas that have a certificate of designation are not subject to Section 5.5, but shall comply with the facility's Engineering Design and Operations Plan.

(E) De minimis projects involving a total RACS disturbance of less than one (1) cubic yard, utilizing low-emission methods, are exempt from this Section 5.5, except for the decontamination procedures in Section 5.5.7(I) and the disposal requirements in Section 5.5.8.

(F) Projects conducted directly by a homeowner on their residence not used for the purpose of generating of income, including residential landscaping projects and other private

residential soil-disturbing projects conducted after the primary dwelling is built, such as planting trees, digging holes for fence posts, installing sign posts, gardening, other such projects conducted by homeowners on their residence, as described above, are not subject to this Section 5.5, but shall still comply with Sections 5.1 through 5.4 of the Regulations.

(G) Soil disturbing activities involving Non-RACS, where no RACS is present or generated, are not subject to the requirements of Section 5.5, but Non-RACS must be disposed as non-friable asbestos waste in accordance with the disposal requirements set forth in Section 5.2 of the Regulations.

(H) Soil disturbing activities involving debris that only contains metal, glass, plastic, wood, and/or bare concrete with no associated material suspected of being ACM (such as sealants, adhesives, mastics, coatings, adhered materials, or resins), as determined by a CABI, QMP, or generator knowledge, are not subject to the requirements of Section 5.5.

(I) Soil disturbing activities involving debris that only contains green waste or natural stone are not subject to the requirements of Section 5.5.

5.5.3 TRAINING

(A) All personnel inside the regulated work area (RWA) during the disturbance of RACS shall have annual awareness training. Except as provided in Section 5.5.3(F), this training requirement also applies to equipment operators and drivers of trucks carrying contaminated material for offsite disposal or reuse. This training shall cover information necessary to comply with Section 5.5 requirements and the approved project specific RACS management plan (PSMRP) or standard operating procedure (SOP) (if any) including:

- 1) General asbestos awareness; including health effects; and
- 2) Overview of the requirements of Section 5.5 and its implementation; and
- 3) Overview of suspect ACM that requires further evaluation by a CABI; and
- 4) Overview of RACS and Non-RACS; and
- 5) Worker protection, including respiratory protection. An overview of the levels of personal protective equipment (PPE) required for various activities and conditions; and
- 6) Decontamination requirements for equipment and personnel including the establishment of decontamination station(s); and
- 7) Engineering controls in order to prevent visible emissions from leaving the RWA or demonstrate that asbestos is not leaving the RWA above risk-based air thresholds; and
- 8) Overview of RACS handling procedures.

This training shall be conducted by a CABI who is familiar with the site specific plan and/or the Standard Requirements in Section 5.5.7.

Records of this training shall be retained, by the owner/operator, and be available for inspection, for a minimum of one year from the date of the training.

(B) In addition to the annual asbestos awareness training required in 5.5.3(A), all personnel inside the RWA during the disturbance of RACS shall have per-project site-specific awareness training. Except as provided in Section 5.5.3(F), this training requirement also applies to equipment operators and drivers of trucks carrying contaminated material for offsite disposal or reuse. This training shall cover site-specific information necessary to comply with Section 5.5 and the selected management approach for the project (PSRMP, SOPs, or the standard requirements of Section 5.5.7), including:

- 1) An overview of the items from 5.5.3(A) as they pertain to site specific provisions and/or conditions that will affect work practices; and
- 2) Project chain-of-command and identification of authorized personnel with stop work authority, and identification of QPM(s); and
- 3) Hands on training specific to the soil disturbing activities the individual will be performing subject to this Regulation.

This training shall be provided by a CABI who meets the training requirements of 5.5.3(D). Records of this training shall be retained by the owner/operator, and be available for inspection, for the duration of the project for which the training was conducted.

(C) Qualified Project Monitors shall have, at a minimum:

- 1) Annual asbestos awareness training and site specific awareness training under Section 5.5.3(A) and (B); and
- 2) Training from a CABI on identifying debris, exempted materials under Section 5.5.1(A)(3), and the assumption of debris to be RACS as outlined in Section 5.5.1; and
- 3) Training from a CABI on how to implement the standard requirements under Section 5.5.7 and how to perform the duties that a QPM may perform in lieu of a CABI; and
- 4) Training from a CABI on how to implement the provisions of the chosen RACS management approach (PSRMP, SOPs, or standard requirements of Section 5.5.7) and how to perform the duties that a QPM may perform in lieu of a CABI; and
- 5) Forty (40) verifiable hours of direct experience implementing Section 5.5.

Records of this training shall be retained by the owner/operator, and be available for inspection for the duration of the project for which the training was conducted.

(D) Visual Inspection and identification of RACS shall be conducted by a CABI, with forty (40) verifiable hours of on the job asbestos in soils experience on a minimum of three (3) different asbestos in soils projects, conducted under either AQCC Regulation No. 8 or Section 5.5. The CABI shall be independent of the general contractor (GC) and/or abatement contractor

unless the CABI and the GC or abatement contractor are both direct employees of the property owner. However, the GC or abatement contractor may hire a subcontractor CABI, but the CABI shall not be a direct employee of the GC or abatement contractor.

(E) Air monitoring conducted in accordance with this Section 5.5 shall be performed by an Air Monitoring Specialist (AMS).

(F) Truck drivers who do not complete the training in 5.5.3(A) and (B) are ancillary workers. Soil disturbing activities must cease if the truck driver is present within the RWA unless the driver remains in the cab of the truck, the truck's windows and doors remain closed, and the air handling system remains off while the truck is inside the RWA.

5.5.4 RESPONSE TO UNPLANNED RACS DISCOVERY

Soil disturbing activities that expose RACS without previously approved plans are subject to the following requirements:

(A) IMMEDIATE ACTIONS: Immediate actions shall be taken by the person conducting the soil disturbing activity, or representative of the owner or operator, to manage RACS in accordance with Section 5.5 and Section 1.2 definitions of the Regulations (Appendix C). These actions shall include, at a minimum, the following:

(1) Stopping all soil disturbing activities related to RACS, until the 24- hour notification requirements in Section 5.5.4(B), and the interim action requirements in Section 5.5.4(C), are met. In the event of an emergency in which a soil disturbing activity must continue or commence at once, notification shall be made as soon as possible, but within 24 hours of identifying or assuming the presence of RACS within the soil disturbing area. During the initial response to the immediate emergency, the standard requirements of Section 5.5.7 shall be implemented to the extent possible. Within 48 hours, any disturbed and/or exposed RACS shall be managed in accordance with the standard requirements of Section 5.5.7, an approved PSRMP, or an approved SOP.

(2) Establishing and taking measures in order to prevent access to the RWA by unauthorized persons. Instances of unauthorized access not under the control of the owner/operator shall be evaluated to determine if additional access controls are warranted. The unauthorized access, and the response actions taken, shall be documented and provided to the Department within 48 hours of the incident.

(3) Conducting interim surface soil stabilization to reduce emissions including:

a. Polyethylene sheeting or geo-fabric with daily inspection, and inspection after storm events, and repair/replacement of sheeting as necessary to maintain stabilization; or

b. Chemical stabilizer demonstrated to be effective in the stabilization of RACS (e.g. magnesium chloride) with weekly inspection, and inspection after storm events, and re-application of chemical stabilizer as necessary to maintain stabilization; or

c. Minimum of three (3) inches of soil appropriate for unrestricted use; or

d. Other means of stabilization as approved by the Department.

e. Stabilization is not required if RACS is kept adequately wet. Verification of adequately wet conditions shall be conducted at least every two (2) hours, or RACS shall be stabilized by one of the methods described in (3)(a-d) above.

(B) 24-HOUR NOTIFICATION REQUIREMENTS: The owner/operator, or owner/operator representative shall submit a completed Notification of RACS Disturbance form to the Department's Hazardous Materials and Waste Management Division within 24 hours of identifying RACS during a soil disturbing activity.

(C) INTERIM ACTIONS: In accordance with Section 5.5.5, the owner/operator, or owner/operator representative, shall submit to the Department's Hazardous Materials and Waste Management Division, for review and approval, within five (5) working days of the discovery, a PSRMP, SOPs, or indicate the standard requirements of Section 5.5.7 will be followed on the Notification of RACS Disturbance form submitted to the Department.

(D) Once the requirements of Sections 5.5.4(A), (B), and (C) are completed, any soil disturbing activities shall proceed in accordance with applicable requirements.

5.5.5 RESPONSE TO PLANNED RACS MANAGEMENT

Planned soil disturbing activities involving RACS shall be conducted in accordance with the standard requirements identified in Section 5.5.7, and with one of the following management strategies and the associated notification requirement:

(A) PROJECT SPECIFIC RACS MANAGEMENT PLAN (PSRMP);

(1) The owner/operator, or owner/operator representative, shall submit a completed Notification of RACS Disturbance form to the Department's Hazardous Materials and Waste Management Division at least ten (10) working days prior to any planned soil disturbing activity. This notification shall include submittal of a PSRMP conforming to the requirements of Section 5.5.5(A)(2). The Department will acknowledge receipt of a notification of the intent to utilize a PSRMP by mail or electronic correspondence. The PSRMP shall be approved by the Department prior to implementation.

(2) If the owner/operator choose(s) management in accordance with this Section 5.5.5(A), a PSRMP shall be developed and submitted to the Department's Hazardous Materials and Waste Management Division for review and approval prior to implementation. The Department will use its best efforts to review and respond to the plan within ten (10) working days of receipt. The PSRMP shall include the following:

(a) Property representative's name and phone number; and

(b) Property location; and

(c) General site description, including a description of RACS and the types of known or assumed ACM(s), and the location(s) of these material on the site; and

(d) Description of planned soil disturbing activities; and

(e) Description of site management, emission control activities, and work practices to control the release of, and/or exposure to, asbestos outside of the RWA including:

(i) Measures to assure that the soil is adequately wet (as that term is defined in Section 1.2 of the Regulations, appendix C), stabilized, or covered during soil disturbing activities; and

(ii) Wind speed monitoring during RACS disturbance, including frequency of monitoring, and shutdown and start up criteria; and

(iii) Air monitoring plan designed to detect asbestos at the perimeter of the RWA as an indication that the measures to control the release of asbestos outside of the RWA are effective. The plan may include a tiered air monitoring approach providing less frequent air monitoring given demonstrated effectiveness of work practices; and

(iv) Work practices specific to mechanical and/or hand disturbance of RACS including measures in order to prevent the release of visible emissions outside of the RWA, or demonstrate that asbestos is not leaving the RWA above risk-based air thresholds; and

(v) Work practices for the loading and placement of RACS including spill prevention procedures; and

(vi) The owner /operator has the option to erect a structure maintained at a negative pressure differential sufficient to contain all dust, with off-gas from the evacuation system treated with HEPA filtration. If this option is chosen, the requirement to submit an air monitoring plan, under Section 5.5.5(A)(2)(e)(iii) is not applicable.

(f) Description and location of any planned sampling. All sampling shall be performed in accordance with the procedures set forth in Appendix 5A. All investigation derived waste shall be managed in accordance with Section 5.5.8.

(3) A copy of the PSRMP shall be maintained on the site during RACS disturbing activities.

(4) At the option of the owner/operator and upon notice to the Department, a Soil Characterization and Management Plan approved prior to the effective date of this amended Section 5.5, and that complies with the substantive requirements of the regulation prior to amendment, shall remain in effect until the completion of the subject project or until it is replaced by a PSRMP.

(B) STANDARD OPERATING PROCEDURES (SOPs)

(1) The owner/operator, or owner/operator representative, shall notify the Department's Hazardous Materials and Waste Management Division, by submitting a completed Notification of RACS Disturbance form, prior to implementation of the previously approved SOPs at a RWA. SOPs that conform to Section 5.5.5(B)(2) shall be approved by the Department

prior to implementation. The Department will acknowledge receipt of a notification of the intent to utilize an SOP by mail or electronic correspondence.

(2) If the owner/operator chooses management in accordance with this Section 5.5.5(B), the owner/operator shall develop and submit to the Department's Hazardous Materials and Waste Management Division, for review and approval, thirty (30) calendar days in advance of any RACS disturbing activities, SOPs that conform with Section 5.5.5(A)(2)(a) – (f) that will be implemented, upon notice to the Department per Section 5.5.5(B)(1), at future RWA(s). A copy of the SOPs shall be maintained on site during RACS disturbing activities for the duration of the Project.

(3) At the option of the owner/operator and upon notice to the Department, a SOP approved prior to the effective date of this amended Section 5.5, and that complies with the substantive requirements of the regulation prior to amendment, shall remain in effect and may be used to comply with the amended regulation.

(C) STANDARD REQUIREMENTS OF SECTION 5.5.7

The owner/operator, or owner/operator representative, shall submit to the Department's Hazardous Materials and Waste Management Division a completed Notification of RACS Disturbance form indicating the intent to utilize the standard requirements of Section 5.5.7, as a default RACS management plan, prior to any planned soil disturbing activity. This notification shall include property location, general site description, and contact information for the owner/operator responsible for the RWA activities. The Department will acknowledge receipt of a notification of the intent to utilize the standard requirements of Section 5.5.7 by mail or electronic correspondence.

(D) RISK BASED APPROACH

The owner/operator may choose to submit, for Department review and approval, a site-specific risk assessment work plan to evaluate the risks of the proposed work practices associated with planned disturbance activities in an area or areas of RACS.

5.5.6 REMEDIATION OF ASBESTOS IN SOIL

(A) Remediation is not required of properties at which ACM, RACS, or asbestos waste is located. If the owner of a property chooses to remediate (rather than just manage) all or a portion of the property containing ACM, RACS, or asbestos waste a Remediation Plan shall be submitted to the Department's Hazardous Materials and Waste Management Division for review and approval prior to commencement of activities associated with the remediation. The Remediation Plan shall comply with this Section 5.5, and include the following:

(1) The standard requirements in accordance with Section 5.5.7, and the plan requirements outlined in Section 5.5.5(A). Alternatively, a risk based approach pursuant to Section 5.5.5(D) may be proposed, for Department review and approval, for disturbance of RACS; and

(2) A detailed description of planned remediation activities, including proposed depth and areal extent of remediation, and work practices to be implemented; and

(3) The proposed use of the property and area of remediation; and

(4) Any planned engineering or institutional controls in order to prevent exposure to any asbestos left in place, or minimize exposure below a risk-based concentration approved by the Department, within the area covered by the Remediation Plan, and

(5) A schedule for submittal of a Remediation Completion Report that incorporates the information from Section 5.5.7(L) and any additional information necessary to demonstrate that the remediation goals have been achieved.

(B) The Department shall use its best efforts to provide written notification that a Remediation Plan has been approved or disapproved within no more than forty-five (45) calendar days after a request by a property owner, unless the property owner and the Department agree to an extension of the review to a date certain.

(C) If a remedial decision is made by the Department, the area subject to the remedial decision may be subject to C.R.S. Section 25-15-320(2), and an environmental covenant may be required for waste left in place.

5.5.7 STANDARD REQUIREMENTS FOR THE DISTURBANCE OF RACS

The requirements of this section, if followed in their entirety, constitute a default RACS management plan, eliminating the need to submit a PSRMP or SOP.

(A) ESTABLISHMENT AND CONTROL OF A REGULATED WORK AREA (RWA)

(1) Requirements for establishment and control of a RWA applicable to all projects subject to this Regulation:

(a) Establish a RWA which is identifiable to all persons. Haul roads between RWAs, where RACS is not present, are considered to be outside the RWA(s); however, equipment decontamination [Section 5.5.7(I)] and spill response procedures [Section 5.5.7(J)] shall be followed; and

(b) Stop all soil disturbing activities in the RWA if ancillary workers or members of the public are present within the RWA. Truck drivers who do not complete the training under Sections 5.5.3(A) and (B) are ancillary workers. Soil disturbing activities must cease if the truck driver is present within the RWA unless the driver remains in the cab of the truck, the truck's windows remain closed, and the air handling system remains off while the truck is inside the RWA; and

(c) Post labeling and signage to demarcate RWA(s). The RWA shall be demarcated by visible means that fully defines the extent of the RWA. Labeling and signage shall indicate the presence of asbestos, and that the area is off limits to unauthorized personnel.

(2) Additional Requirement for Projects Disturbing RACS Containing Friable ACM. Establish a secured work site (e.g., fencing with locks/zip-ties/chains). Personnel, or staff assigned to this duty, may be used to secure the RWA in lieu of fencing. If the RWA is located within a larger secure facility, fencing of the RWA is not necessary as long as the RWA is secured.

(B) PERSONAL PROTECTIVE EQUIPMENT (PPE) FOR THE PURPOSES OF PREVENTING CROSS-CONTAMINATION

(1) Requirements applicable to all RWAs subject to this Regulation:

(a) Use of disposable booties or impermeable footwear that will be decontaminated per Section 5.5.7(I); and

(b) Use of disposable gloves or impermeable gloves that will be decontaminated per Section 5.5.7(I); and

(c) Replace or decontaminate (per Section 5.5.7(I)) all PPE in all instances where the integrity of the PPE is compromised, and when workers exit the RWA; and

(d) Decontaminate (per Section 5.5.7(I)) or dispose of all used PPE as asbestos contaminated waste.

(2) Additional Requirement Applicable to Projects at RWAs Containing Friable ACM. Use of disposable impermeable suits or equivalent coveralls, remove suits or coveralls upon exiting the RWA, and dispose of used suits or coveralls as asbestos contaminated waste.

(C) WETTING

(1) Wetting requirements applicable to all RACS disturbance:

(a) Adequately wet all RACS and soils, or other materials containing RACS, on the surface and in the sub-surface prior to and during RACS disturbance, except as provided in Section 5.5.7(F)(1)(b)(ii). Pre-wetting is not necessary if soils are already adequately wet. Apply water or amended water (as required in Section 5.5.7(C)(2)) at low pressure in order to minimize dust generation and splattering to prevent visible emissions from leaving the RWA, or demonstrate that asbestos is not leaving the RWA above risk-based thresholds.

(b) Mist RACS and soils, or other materials, containing RACS during placement as needed to maintain the material in an adequately wet condition using equipment mounted spray bars, or additional hose operator(s).

(c) Except as provided in (d) below, incidental occurrences of visible emissions leaving the RWA shall be managed by evaluating site conditions and engineering controls for each occurrence of visible emissions, and immediately implementing any identified engineering control revisions necessary in order to prevent future occurrences of visible emissions. All instances of visible emissions leaving the RWA shall be documented as required in Section 5.5.7(L) of this regulation.

(d) When utilizing the risk-based air monitoring threshold approach to evaluate the effectiveness of adequately wetting, visible emissions are allowed to leave the RWA as long as the risk-based air threshold is not exceeded.

(2) Additional requirement for RACS that contains friable ACM. Use amended water containing a wetting agent, such as a 50:50 mixture of polyoxyethylene ester and polyoxyethylene ether, or the equivalent, in a 0.16 percent solution (1 ounce to 5 gallons) of water, or as per manufacturer recommendations for the wetting of asbestos. This requirement may be waived by the Department for emergency situations where the work must occur immediately and wetting agents are not available.

(D) WIND SPEED MONITORING

(1) Requirements applicable to all projects involving mechanical disturbance of RACS, and hand disturbance of RACS containing friable ACM:

(a) Take wind measurements from within the RWA using a hand held anemometer. Alternatively, or in conjunction with hand held measurements, an onsite weather station may be used within a quarter mile of the RWA as long as the conditions measured by the weather station are representative of conditions in the RWA.

i. Collect wind speed measurements at a minimum of thirty (30) minute intervals and during wind gust(s). Average wind speed measurements shall be obtained manually by taking ten readings at one minute intervals and averaging the ten readings, or through the use of instrumentation that provides a ten minute average wind speed reading.

ii. If wind break barriers are used, wind speed measurements may be taken from within barriers; however, wind speed measurements shall also be taken outside the wind break barriers if any RACS disturbing activities, such as loading, are taking place outside or above the barriers. Wind speed shut-down criteria shall be based on measurements taken that are representative of the area of active RACS disturbance.

(b) Immediate stoppage of all RACS disturbance shall occur based on results of wind speed monitoring conducted in accordance with subsection (a) and exceedance of the following criteria:

- i. Wind gust(s) in excess of 20 mph, or
 - ii. Sustained winds in excess of 12 mph, averaged over ten(10) minutes, or
 - iii. Winds are interfering with the ability of engineering controls to work as intended, or
 - iv. Winds are creating visible emissions that leave the RWA.
- (c) RACS disturbance may resume when all of the following criteria are met:

- i. No gust(s) in excess of 20 mph occur for twenty (20) minutes, and
- ii. No sustained winds in excess of 12 mph occur for twenty (20) minutes, based on a ten (10) minute average wind speed measurement, and
- iii. Winds are not interfering with the ability of engineering controls to function as intended, and
- iv. Winds are not creating visible emissions that leave the RWA.

(E) AIR MONITORING

(1) If using the risk-based air threshold approach to monitor the effectiveness of adequately wetting:

(a) Air monitoring to determine asbestos content of visible emissions allowed to leave the RWA, for comparison to the risk- based air thresholds shall not be utilized for projects that are less than ten (10) days in duration.

(b) Air monitoring to determine asbestos content of visible emissions allowed to leave the RWA, for comparison to the risk- based air thresholds, shall begin on the first day of the project.

(c) A minimum of four (4) air samples per day shall be collected for TEM analysis.

(d) Sample collection, analysis, and data evaluation shall be conducted in accordance with Appendix 5A.

(2) If preventing visible emissions leaving the RWA as an indication of the effectiveness of work practices, not for risk evaluation, air monitoring is required during mechanical disturbance of RACS in RWAs with an adjacent receptor zone:

(a) No air monitoring is required for RACS disturbance that will not exceed a duration of two (2) days. However, the requirements for adequate wetting (Section 5.5.7(C)) and no visible emissions leaving the RWA (Section 5.5.7(F)) shall be adhered to on all RACS disturbance projects. Dividing projects into multiple two (2) day or shorter components shall not be used as a mechanism to avoid air monitoring requirements.

(b) Area monitoring shall consist of a minimum of four (4) samples collected on the perimeter of the RWA at appropriate intervals to provide representative information regarding potential releases of asbestos fibers to the adjacent receptor zone(s). Additional samples shall be collected for large perimeter RWAs (greater than one (1) acre). RWAs greater than one (1) acre shall require additional perimeter monitoring points be added at a rate of one (1) sample for every 200 linear feet (or approximately each additional ¼ acre). If representative information about potential releases to the adjacent receptor zone(s) can be collected using less than the minimum number of samples, the remaining sample locations shall be at the discretion

of the AMS.

(c) Phase Contrast Microscopy (PCM) analysis is required on all samples collected (unless all samples will be analyzed by Transmission Electron Microscope (TEM) by default). The laboratory shall be requested to provide verbal results to the AMS or the QPM by the start of the next working day, or as soon as possible after the start of the next working day, with written results within 24 hours of the receipt of verbal results. A consultation with the Department is required If this timeframe cannot be met by the laboratory.

(d) Upon receipt of a laboratory report indicating a “cannot be read (CBR)”, or a “not analyzed (NA) or rejected” due to loose debris or uneven loading, analysis result:

- i. The AMS shall evaluate the lab report and any field documentation to determine a possible cause for the CBR or “not analyzed (NA) or rejected” result; and
- ii. If the CBR or “not analyzed (NA) or rejected” cannot be correlated to a specific field event that compromised the sample (e.g. the sample was blown over, the filter of the sample was sprayed with water) then the sample shall be prepared for indirect TEM presence/absence analysis to determine potential asbestos content in accordance with Appendix 5A; and
- iii. If the CBR or “not analyzed (NA) or rejected”, analysis result can be correlated to a compromised sample, then preparation for indirect TEM presence/absence analysis is not required as long as adequate air monitoring data is available to evaluate the effectiveness of engineering controls. However, overloading of a sample with particulate matter does not constitute a compromised sample, and will require indirect preparation for TEM presence/absence analysis; and
- iv. Field personnel shall evaluate why the sample was compromised and modify field procedures as necessary to avoid future samples from being compromised; and
- v. The Department project manager shall be notified by phone or email of instances of CBR or “not analyzed (NA) or rejected” analysis results within 24 hours of receipt of verbal results.

(e) TEM presence/absence analysis is required (analysis providing fiber counts/concentrations is always optional) as described in paragraphs (i) through (iv) below. The laboratory shall be requested to provide verbal results by the start of the next working day, or as soon as possible after the start of the next working day, with written results within 24 hours of the receipt of verbal results.

- i. All samples, required by this Section 5.5, with PCM results having fiber concentrations greater than 0.01f/cc shall be submitted for TEM

analysis.

- ii. During the first five (5) days of RACS disturbance – A minimum of 25% of the samples collected from each RWA, inclusive of the downwind floating samples as described in 5.5.7(E)(2), shall be submitted for TEM analysis. The sample(s) selected for TEM analysis shall have the highest PCM result(s) based on fiber concentration. If all PCM results are Below Detectable Limit (BDL) for fiber concentration, then the sample(s) selected for TEM analysis shall be determined by highest fiber count. If all samples have no fiber counts (i.e. zero (0) fibers counted, not a “below detection limit” fiber concentration) then no TEM analysis is required.
- iii. After five (5) days of RACS disturbance with no asbestos detections by TEM analysis, the frequency of analysis by TEM, on the highest 25% of PCM results(s), may be reduced to once every five (5) days of RACS disturbance, or portions thereof, using the same selection criteria as in paragraphs (i) and (ii) above. The samples submitted for TEM analysis during the period of reduced frequency TEM analysis shall be either the first occurrence of: 1) high winds exceeding wind shut down criteria, or 2) visible emissions. In the absence of high wind events or visible emissions the selected day for TEM analysis may be random, as determined by the AMS.
- iv. If there are any asbestos detections during the random once every five (5) days of RACS disturbance analysis by TEM, then TEM analysis shall be conducted for the next three (3) consecutive days of RACS disturbance, or portions thereof, using the same procedures as in paragraph (i) and (ii) above. If there are no additional asbestos detections during the next three (3) consecutive days of RACS disturbance with samples submitted for TEM analysis, then the frequency of TEM analysis may return to random once every five (5) days of RACS disturbance.
- v. If site conditions, friability of the materials being managed, or work practices change, then the initial five (5) days of TEM analysis shall restart using the provisions set forth in this Section 5.5.7(E)(1)(e).

(f) Detection or presence responses - For each detection of asbestos by TEM analysis, the following shall be conducted:

- i. Notify the Department project manager by phone or email, on the same calendar day as receipt of verbal or written results (whichever comes first) from the laboratory.
- ii. Evaluate site conditions and engineering controls for each detection, and immediately implement any identified engineering control

revisions necessary with the goal of preventing future detections of asbestos fibers.

- iii. Submit an Emission Control Plan (ECP) to the Department project manager for each detection (days with multiple detections can be addressed by a single ECP). The ECP shall be submitted within 48 hours from the asbestos detection event and shall contain:

1. The date of the detection.
2. A written description of sample details (sample ID, number of structures detected, type of asbestos detected, PCM analytical result) and any potential cause of the release. Include a description of site activity (engineering controls being employed, equipment being used, size of excavation/soil disturbing activity, types of materials identified, etc.) and CABI observations at the work area before and during the presumed time of release.
3. A diagram or write up of all air sample positions clearly indicating which sample received the TEM detection. Indicate, through illustration or description, prevailing wind direction and average wind speeds for the detection event; include any wind speed shutdowns for the date of detection. If applicable, indicate downwind floater air sample relocation times and new positions through illustration or description.
4. Laboratory reports confirming the type and amount of fibers detected by TEM analysis.
5. Other pertinent information that will additionally describe the release and/or will assist in the prevention of future releases from the RWA.
6. A written description of actions taken and any other proposed actions with the goal of preventing future releases from the RWA.
7. If the owner/operator believes fibers are coming from offsite and are not under the control of the owner/operator, then, in addition to the information provided in the ECP, documentation shall be provided demonstrating additional sources of asbestos fibers.

(g) If there are three (3) TEM detections on consecutive analysis events or ten (10) detections for a single project, consultation with the Department is required to determine if the standard requirements of Section 5.5.7 are being implemented appropriately and whether:

- i. Changes in the standard requirements of Section 5.5.7 are likely to prevent future releases; or

- ii. Changes in the standard requirements of Section 5.5.7 are not likely to prevent future releases and a PSRMP is necessary per Section 5.5.5(A)(2); or
- iii. If the owner/operator believes fibers are coming from offsite and are not under the control of the owner/operator, then, in addition to the information provided in the ECP, documentation shall be provided demonstrating additional sources of asbestos fibers. Air samples shall be collected and analyzed following the analytical procedures of Appendix 5A for the type of project being conducted; and
- iv. Additional consultation with the Department is required to determine whether additional engineering controls for structures within the adjacent receptor zone are appropriate.

(3) Additional requirement for projects disturbing RACS containing friable ACM. Collect two (2) additional downwind floating samples for mechanical disturbance of RACS containing friable ACM. The samplers shall be moved based on prevailing wind direction and adjacent receptors. For example, if adjacent receptors are present on only one side of the RWA, one sample location should be maintained between the RWA and the adjacent receptor.

(F) WORK PRACTICES TO BE FOLLOWED DURING RACS DISTURBANCE

(1) Work practice requirements applicable to all management of RACS:

(a) Prevent visible emissions from leaving the RWA, or demonstrate that asbestos is not leaving the RWA above risk based thresholds by:

- i. Excavating in lifts not to exceed the extent of wetting; or
- ii. Conducting continuous wetting while mixing dry materials at the point of RACS disturbance to ensure all materials are adequately wet prior to removal from the excavation.
- iii. Instances of visible emissions leaving the RWA shall be documented and addressed by changing or increasing controls (e.g. more effective wetting, reduced speed of excavation).

(b) RACS on exposed excavation faces that will be disturbed and/or managed during the project shall either be kept adequately wet (in accordance with Section 5.5.7(C)), or be stabilized using any of the following in order to prevent visible emissions from leaving the RWA, or demonstrate that asbestos is not leaving the RWA above risk based thresholds:

- i. Polyethylene sheeting or geofabric with daily inspection, and inspection no later than twelve (12) hours following a storm event, and repair/replace sheeting as necessary to maintain stabilization; or

- ii. Chemical stabilizer demonstrated to be effective in the stabilization of RACS (e.g. magnesium chloride) with weekly inspection, and inspection no later than one (1) calendar day following a storm event, and re-application of chemical stabilizer as necessary to maintain stabilization; or

- iii. Minimum of three (3) inches of soil appropriate for unrestricted use.

(c) Stormwater shall be managed in accordance with the Water Quality Control Commission's stormwater Regulations (5 CCR 1002-61), which include specific stormwater permitting and management requirements for construction sites. The Water Quality Control Division should be contacted to determine the specific requirements for each project. Stormwater shall be managed in a manner that minimizes run on and runoff from RACS. Stormwater that comes into contact with RACS shall be treated as asbestos contaminated water in accordance with Section 5.5.7(J)(4), and other material(s) impacted by asbestos contaminated stormwater shall be managed as RACS in accordance with Section 5.5.7(J)(3).

(2) Work Practice requirements applicable to the management of RACS using hand methods on surfaces or in the subsurface:

- a. Wet and remove the RACS and six (6) inches, in all directions, of surrounding soil or other material from the last occurrence of visible ACM; and
- b. A CABI shall confirm that the visible extent of ACM and surrounding soil, or other material, has been removed (or extent of excavation has been reached). If RACS remains, it shall be managed for stabilization or future removal. If there is no documented evidence of non-visible RACS at the site, then a visual inspection and clearance shall be sufficient to determine the removal of RACS. If there is documented evidence of non-visible RACS at the site, sampling is required to confirm the removal of RACS. After the removal of the additional six (6) inches, and in the absence of any debris, a QPM may make the determination that RACS has been removed; and
- c. If RACS remains in the RWA, it shall be managed for stabilization, per Section 5.5.7(K), or future removal.
- d. In lieu of stabilization or full removal, sampling may be performed per Section 2.2 of Appendix 5A to demonstrate that the material is not RACS.
- e. Dispose of RACS in accordance with Section 5.5.8.

(3) Work practice requirements applicable to management of RACS using mechanical methods:

- a. For surface occurrence of RACS - Wet and remove all RACS and a minimum of six (6) inches of soil, and/or other matrix material, in all directions from the last occurrence of visible ACM, with CABI confirmation that the visible extent of RACS has been removed.

b. For subsurface occurrence of RACS - Wet and remove all RACS and a minimum of three (3) linear feet of soil or other matrix material, in the direction(s) of planned excavation, with CABI confirmation that the visible extent of RACS has been removed. If there is no documented evidence of non-visible RACS at the site, then a visual inspection and clearance shall be sufficient to determine the removal of RACS. If there is documented evidence of non-visible RACS at the site, sampling is required to confirm the removal of RACS. After the removal of the additional three (3) linear feet, and in the absence of any debris, a QPM may make the determination that RACS has been removed.

c. If RACS remains in the RWA, it shall be managed for stabilization, per 5.5.7(K), or future removal.

d. In lieu of stabilization or full removal, sampling may be performed per Appendix 5A to demonstrate that the material is not RACS.

e. Package and dispose of RACS in accordance with Section 5.5.8.

(4) Soil or other matrix material that remains after removal of RACS in accordance with Section 5.5.7(F), Section 5.5.7(H)(1)(c)(i), or an approved plan, is not considered RACS, is not subject to Section 5.5, and may be appropriate for unrestricted use, onsite or offsite, as long as it does not contain any other regulated material.

(G) LOADING AND PLACEMENT OF RACS

(1) Requirements for the loading of RACS:

(a) Protect clean surfaces (including loading surface and truck or disposal container surfaces that may come in contact with RACS) by covering or decontamination of surfaces prior to transport or removal of the truck or disposal container from the RWA and/or loading zone.

(b) Spill prevention shall consist of:

- i. Minimization of spillage by not overfilling the excavator or loader bucket and returning the bucket to a closed position prior to moving from the loading point; and
- ii. Replacement of protective coverings when worn or damaged in order to prevent breaches; and
- iii. Control of runoff in order to prevent cross contamination from water containing asbestos; and
- iv. Mitigation of spills of RACS in accordance with Section 5.5.7(J).

(c) During the process of loading the container, the equipment operator shall lower the bucket as close as possible to the interior of the container before dumping, and dump the load slowly to allow adequate misting and in order to prevent visible emissions from leaving

the RWA, or demonstrate that asbestos is not leaving the RWA above risk based thresholds.

(2) Requirements for the transportation of RACS:

(a) Onsite transportation of RACS between the RWA and an onsite area of staging, stockpiling, storage, disposal or reuse shall comply with the following:

- i. The packaging requirements for RACS set forth in Section 5.5.8(A) of the Regulations and this plan are not applicable; however, the decontamination requirements of Section 5.5.7(I) shall be followed at the end of disposal operations, or before disposal equipment is removed from the site; and
- ii. Driving speeds shall not exceed 12 miles per hour or RACS shall be covered during transport; and
- iii. For transportation between the RWA and a non-contiguous onsite staging, stockpiling, storage, disposal, or reuse area:
 1. Transportation equipment tires shall not contact RACS; or
 2. RACS that is driven upon is a RWA and shall be kept adequately wet in order to prevent visible emissions from leaving the RWA, or demonstrate that asbestos is not leaving the RWA above risk based thresholds, and all equipment surfaces that have come into contact with RACS shall be decontaminated per Section 5.5.7(I) before leaving the RWA; or
 3. The haul road shall be managed as RACS for stabilization, per Section 5.5.7(F)(1), and future removal of a minimum of three (3) inches of soil, or other matrix material. If the road is constructed of a durable surface such as concrete or asphalt, the surface shall be decontaminated in accordance with Section 5.5.7(I)(1)(b) using wet methods, followed by CABI inspection verifying that all soil and debris has been removed from the surface. Rinsate/runoff shall be collected and filtrated to less than 5 microns (or applicable local requirements) and discharged to a sanitary sewer or other Department- approved disposal facility or re-applied to RACS that will be managed under the Regulations and this plan.

(H) ONSITE STAGING, STOCKPILING, AND STORAGE OF RACS

(1) Staging, as defined in Section 1.2 of the Regulations (Appendix C), is the accumulation and temporary storage of RACS in the RWA for 12 hours or less. The following requirements shall apply to the staging of RACS:

- (a) Staged RACS shall be kept adequately wet.

(b) Staging of RACS shall be on 6 mil, or greater, polyethylene sheeting or shall include removal, and management as RACS, of a minimum of three (3) inches of material, from below the staging pile/area prior to demobilization; with visual or measured confirmation of removal. If polyethylene sheeting is placed on top of a durable surface such as concrete or asphalt, the surface must be decontaminated using wet methods, followed by CABI inspection verifying that all soil and debris has been removed from the surface. Rinsate/runoff shall be collected and filtrated to less than 5 microns (or applicable local requirements) and discharged to a sanitary sewer or other Department- approved disposal facility or re-applied to RACS that will be managed under the Regulations and this plan.

(c) Material determined to be clean during generation shall be inspected during placement for staging. Staging of clean material with incidental discovery of RACS shall be managed as follows:

- i. If a CABI was continually inspecting the material during generation, remove the piece of ACM and one (1) foot of material in all directions, with CABI confirmation that the visible extent of RACS has been removed. If more than one (1) piece of ACM, or a pocket of ACM is discovered, remove the pocket of ACM plus one (1) foot of material in all directions, with CABI confirmation that the visible extent of RACS has been removed. Material that remains after removal of RACS, and CABI visible confirmation, is not considered RACS, is not subject to Section 5.5, and may be appropriate for unrestricted reuse, onsite or offsite, as long as it does not contain any other regulated material.
- ii. If a CABI was not continually inspecting the material during generation, an intrusive inspection of the pile shall be conducted to determine the extent of RACS contamination, followed by the removal of the visible extent of contamination plus removal of one (1) foot of material in all directions. Alternatively, the entire pile, plus three (3) inches of material below the pile, shall be removed and managed as RACS. If the pile was placed on top of a durable surface such as concrete or asphalt, the surface shall be decontaminated using wet methods, followed by CABI inspection verifying that all soil and debris has been removed from the surface. Rinsate/runoff shall be collected and filtrated to less than 5 microns (or applicable local requirements) and discharged to a sanitary sewer or other Department-approved disposal facility or re-applied to RACS that will be managed under the Regulations and this plan.

(2) Stockpiling, as defined in Section 1.2 of the Regulations (Appendix C, is the accumulation and storage of RACS that will exist for more than twelve (12) hours, up to and including ten (10) calendar days. The following requirements shall apply to stockpiled RACS:

(a) Stockpiled RACS shall be placed on a minimum of 6 mil polyethylene sheeting or shall include removal, and management as RACS, of a minimum of three (3) inches of soil, or other matrix material, from under the entire area of RACS stockpiling after stockpile

removal. If the stockpile was placed on top of a durable surface such as concrete or asphalt, the surface must be decontaminated using wet methods, followed by CABI inspection verifying that all soil and debris has been removed from the surface. Rinsate/runoff shall be collected and filtrated to less than 5 microns (or applicable local requirements) and discharged to a sanitary sewer or other Department- approved disposal facility or re-applied to RACS that will be managed under the Regulations and this plan.

(b) RACS shall be adequately wet during disturbance.

(c) Stockpiled RACS shall be controlled per Section 5.5.7(A).

(d) Stockpiled RACS shall be stabilized by:

- i. Polyethylene sheeting or geotechnical fabric with daily inspection, and inspection no later than twelve (12) hours following storm events, and repair/replace sheeting as necessary to maintain stabilization; or
- ii. Chemical stabilizer demonstrated to be effective in the stabilization of RACS (e.g. magnesium chloride) with weekly inspection, and inspection no later than one (1) calendar day after storm events, and re-application of chemical stabilizer as necessary to maintain stabilization; or
- iii. Minimum of three (3) inches of soil appropriate for unrestricted use.

(e) For stockpile areas that are non-contiguous with the RWA, transportation of RACS shall be conducted in accordance with the following:

- i. Transportation equipment tires shall not contact RACS; or
- ii. The tires shall be decontaminated per Section 5.5.7(I) before leaving the RWA; or
- iii. The haul road shall be managed as RACS for stabilization, per Section 5.5.7(H)(2)(d), and future removal of a minimum of three (3) inches of soil, or other matrix material. If the road is constructed of a durable surface such as concrete or asphalt, the surface shall be decontaminated using wet methods, followed by CABI inspection verifying that all soil and debris has been removed from the surface. Rinsate/runoff shall be collected and filtrated to less than 5 microns (or applicable local requirements) and discharged to a sanitary sewer or other Department- approved disposal facility or re-applied to RACS that will be managed under the Regulations and this plan.

(f) For a stockpile that was previously thought to be free of RACS, but where RACS is subsequently identified, the procedure outlined in Section 5.5.7 (H)(1)(c) shall be followed.

(3) Storage of RACS exceeding ten calendar days shall require the submission of a RACS Storage Plan. Storage of RACS shall not commence prior to approval of the RACS Storage Plan by the Department's Hazardous Materials and Waste Management Division. The RACS Storage Plan shall include:

- (a) Approval of storage with signature from the property owner; and
- (b) Volume of RACS intended for storage; and
- (c) Liner design or provisions for removal of a minimum of three (3) inches of underlying material; and
- (d) Storm water design including protections for run-on and run-off; and
- (e) Cover design or use of an equivalent durable stabilizer; and
- (f) Access control and signage; and
- (g) Storage timeframe (shall not exceed six (6) months unless an extended storage timeframe is approved by the Department and complies with local governing authority requirements); and
- (h) Inspection and maintenance schedule; and
- (i) Closure and removal requirements; and
- (j) Documentation and reporting; and
- (k) Certification of any designed elements by a Colorado registered Professional Engineer.

(4) Temporary sub-surface storage of RACS in areas of future planned RACS removal shall not exceed six (6) months and shall comply with the following:

- (a) RACS may only be placed within the Area of Contamination (AOC) that it was originally removed from.
- (b) Placement of RACS utilizing standard RACS management requirements in accordance with the standard requirements of Section 5.5.7, an approved PSRMP, or an approved SOP.
- (c) Cover RACS in accordance with the requirements of Section 5.5.7(K).
- (d) RACS not removed within six (6) months (unless an extended storage timeframe is approved by the Department), shall be considered disposal in accordance with Section 5.5.8(A), or reuse within an AOC and will require an environmental covenant in accordance with Section 5.5.8(B)(1).

(5) Offsite staging, stockpiling, and storage of RACS are allowed as long as they comply with the disposition requirements of Section 5.5.8.

(I) DECONTAMINATION

(1) Requirements applicable to all projects subject to Section 5.5:

(a) Personnel Decontamination:

- i. Remove booties and/or gloves before exiting RWA and dispose as asbestos contaminated waste; or
- ii. If not using disposable PPE, decontaminate boots in a boot wash station, remove gloves after exiting the boot wash station, and dispose of gloves as asbestos contaminated waste. Rinsate from the boot wash station shall be collected, filtrated to less than 5 microns (or applicable local requirements) and discharged to a sanitary sewer or other Department-approved disposal facility, or re-applied to RACS that will be managed under the Regulations and this plan.

(b) Decontamination of Equipment or Surfaces that have come into Contact with RACS

i. For equipment that comes into contact with RACS:

1. Wet decontamination on a decontamination pad (minimum 10 mil poly or other durable non-permeable barrier) followed by CABI inspection and verification of equipment decontamination before it leaves the decontamination area. All decontamination liquids and solids shall be contained, and run-on and run-off shall be prevented. Rinsate/runoff shall be collected, filtrated to less than 5 microns (or applicable local requirements) and discharged to a sanitary sewer or other Department- approved disposal facility or re-applied to RACS that will be managed under the Regulations and this plan. For breaches in the decontamination pad where RACS or water contaminated with asbestos may have impacted the material below the decontamination pad, implement the provisions of Section 5.5.7(J); and/or
2. Decontamination using HEPA vacuums followed by CABI inspection and verification of equipment decontamination before it leaves the decontamination area.

(c) Protection of Clean Equipment and Surfaces:

- i. Keep all equipment off of RACS; or
- ii. Protect clean surfaces from coming in contact with RACS by covering

equipment surfaces or RACS surfaces with polyethylene sheeting or equivalent durable impermeable covering. For onsite movement of excavation equipment between RWAs, where only the excavator bucket has come in contact with RACS, the bucket shall be wrapped in polyethylene sheeting (minimum 6 mil) prior to movement. Protective coverings shall be cleaned, repaired, or replaced as necessary. If protective coverings are breached and RACS or asbestos contaminated water comes into contact with underlying material, the provisions of Section 5.5.7(J) shall be followed. Coverings that have come in contact with RACS shall be disposed as asbestos contaminated waste.

(2) Additional Requirements for Projects Disturbing RACS Containing Friable

ACM:

(a) Remove disposable impermeable suits or equivalent coveralls before exiting RWA and dispose as asbestos contaminated waste, or

(b) After removal of suits or coveralls, conduct full wet decontamination prior to exiting RWA with collection of rinsate and filtration to less than 5 microns and discharge to a sanitary sewer or other Department-approved disposal facility. Re-application of decontamination shower water is prohibited.

(J) RACS SPILL RESPONSE

(1) Areas where RACS is spilled are RWAs until clean up is completed.

(2) Spilled material shall be cleaned up immediately and not allowed to dry out or accumulate on any surface. The Department's Hazardous Materials and Waste Management Division shall be notified, through the spill reporting hotline, in the event that spills of RACS cannot be cleaned up within 24 hours of spill identification.

(3) Where there are breaches in ground coverings that have the potential to allow RACS or water contaminated with asbestos to impact the material below the covering, a minimum of three (3) inches of soil, or other matrix material, shall be removed from beneath the breached ground coverings. Visual or measured (e.g. survey) confirmation that three (3) inches of soil and/or other matrix material from beneath the breached covering has been removed shall be conducted. If ground coverings are placed on top of a durable surface such as concrete or asphalt, the surface shall be decontaminated using wet methods, followed by CABI inspection that all soil and debris has been removed from the surface.

(4) Rinsate, runoff, or any other water that has come into contact with RACS shall be considered to be asbestos contaminated water and shall be collected and filtrated to less than 5 microns and discharged to a sanitary sewer or other Department-approved disposal facility or re-applied to RACS that will be managed under the Regulations and this plan.

(5) Surfaces that are contacted by asbestos contaminated water shall be managed as RACS as per Section 5.5.7(J)(3) or permanently stabilized as per Section 5.5.7(K).

(6) If work practices in an RWA are causing an ongoing spill outside the RWA, the work practices shall cease or be modified to prevent additional releases.

(K) REQUIREMENTS FOR EXPOSED RACS REMAINING IN PLACE

(1) Any remaining RACS that has been exposed by the soil disturbing activity, but is not disturbed, such as an excavation side-wall or bottom shall be covered or stabilized using one of the following:

- (a) Cover RACS with geofabric, followed by eighteen (18) inches of fill suitable for unrestricted use, and vegetation; or
- (b) Cover RACS with geofabric, followed by six (6) inches of fill suitable for unrestricted use, and concrete or asphalt; or
- (c) Cover RACS with geofabric, followed by fill suitable for unrestricted use to grade or six (6) inches, whichever is greater, for vertical excavation faces or trenches; or
- (d) Alternate cover designs as approved by the Department.

(L) DOCUMENTATION

(1) The documents listed below shall be maintained during a project and available for Department review upon request. However, this documentation need not be submitted to the Department unless requested. CABI and AMS notes may be collected by one individual if they possess both certifications; however, if no AMS is onsite the CABI shall provide items listed in the AMS notes section (e.g. wind monitoring and shutdown events). CABI and AMS notes may be taken by another individual, but shall be reviewed, approved, and signed by the CABI or AMS for whom the notes are being taken. Other appropriate personnel may also provide the following documentation.

- (a) CABI/QPM Notes shall include documentation of:
 - i. Site description including location; and
 - ii. Descriptions of site activities; and
 - iii. Descriptions of equipment in use; and
 - iv. Descriptions of hand removals (including locations); and
 - v. Descriptions of types of debris identified; and
 - vi. Descriptions of suspect material identified; and
 - vii. Friability of ACM identified (as determined by a CABI); and
 - viii. Sampling, if conducted (all sampling shall be conducted by a CABI);

and

- ix. Decontamination visual inspection and clearances; and
- x. Excavation visual inspection and clearances; and
- xi. Spill response activities; and
- xii. Observations of visible emissions and responses; and
- xiii. Observations of non-earthen material or the appearance of fill; and
- xiv. Observations of other indicators of impact to soils.

(b) AMS notes shall include documentation of:

- i. Wind speed measurements; and
- ii. Prevailing wind direction(s); and
- iii. Wind shut down event(s); and
- iv. Initial air sample locations; and
- v. Air sample relocation notes; and
- vi. Observations of visible emissions and responses; and
- vii. Notes pertaining to sample malfunctions (pump faults, overloading, etc.); and
- viii. Instances of samples being compromised (samples knocked over, sample filters being sprayed with water, samples physically impacted by equipment, etc.); and
- ix. Air sample data (flow rates, time of sampling, volumes, calibration method, etc.).

(c) General documentation shall include:

- i. Disposal records; and
- ii. Analytical reports including chain of custody forms; and
- iii. Evaluations of any samples with a “cannot be read” analysis result and the notifications of these events to the Department; and
- iv. Location of known remaining RACS; and

- v. Creation and removal dates for, and locations of, staged, stockpiled, and/or stored RACS; and
- vi. Stockpile and staging pile inspection logs and documentation of weather events requiring inspection; and
- vii. Logs of all site personnel with access to the RWA; and
- viii. Certification records for all CABIs and AMSs utilized on the project, and
- ix. Records for training conducted in accordance Sections 5.5.3(A) and 5.5.3(B); and
- x. Records demonstrating the QPM(s) meet the training and experience requirements set forth in Section 5.5.3(C); and
- xi. ECP(s) generated during the project.

5.5.8 PACKAGING AND DISPOSITION OF REGULATED ASBESTOS CONTAMINATED SOIL (RACS)

(A) Disposal of RACS

(1) RACS containing one percent (1%) or greater of friable ACM (as determined in the field by a CABI) by volume per load or container, based on visual estimation through continuous visual inspection or other Department-approved quantifiable means of measurement, shall be packaged in a leak tight container and disposed as friable asbestos waste, in accordance with Section 5.3 of the Regulations. Alternatively, a friable ACM determination by a CABI is not required if the disposal load is assumed to be RACS containing 1% or greater of friable ACM and is packaged and disposed of in accordance with Section 5.3 of the Regulations. Documentation shall accompany each load of RACS removed from the site stating that soil originating from this site shall not be used as daily cover or reused offsite.

(2) For RACS containing:

(a) Less than one percent (1%) of friable ACM (as determined in the field by a CABI) by volume, per load or container, based on visual estimation through continuous visual inspection, or other Department-approved quantifiable means of measurement, shall be packaged in a leak tight container and disposed in a manner similar to non-friable asbestos waste, as described in Section 5.2 of the Regulations. Documentation must accompany each load of RACS removed from the site stating that soil originating from this site shall not be used as daily cover or reused offsite.

(b) Except as provided by Section 5.5.8(A)(3), only visible non- friable ACM (as determined in the field by a CABI) that has not been rendered friable, or RACS that contains no visible ACM, shall be packaged in a leak tight container and disposed of as non-friable asbestos waste in accordance with Section 5.2 of this Part 5. Documentation shall accompany

each load of RACS removed from the site stating that soil originating from this site shall not be used as daily cover or reused offsite.

(c) A total volume of debris that is less than 1% of the disposal load, based on visual estimation through continuous visual inspection, and the debris is all assumed to be RACS, then a CABI is not required to make a friable ACM determination.

(3) Owners/operators may utilize alternative packaging for RACS, that contains only non-friable ACM and/or asbestos fibers in soil, that ensures that there are no visible emissions during transport to or from the landfill. The alternative packaging must also be acceptable to the disposal facility accepting the waste. A written notice shall be submitted to the Department at least forty-eight (48) hours prior to the alternative packaging being used. If alternative packaging will be used for material that contains any amount of friable asbestos waste, the alternative packaging shall be in accordance with Section 5.3.5 of the Regulation.

(4) A Design and Operations (D&O) plan shall be submitted to, and approved by, the Department for onsite disposal of RACS outside of the AOC, in accordance with the Colorado Solid Wastes Disposal Sites and Facilities Act (C.R.S. 30-20, Part 1) and the Regulations. The packaging requirements set forth above in Section 5.5.8(A)(1-2) are not required for onsite disposal, but the requirements of Section 5.5.5(A)(2)(e) are applicable. An environmental covenant, in accordance with 25-15-320, C.R.S., is required for onsite RACS disposal, and a Certificate of Designation shall be required, in accordance with Section 1.6 of the Regulations, unless exempt under Section 1.4.

(B) Onsite reuse of RACS:

(1) A plan for reuse of RACS within the footprint of the AOC shall be submitted to the Department for review and approval prior to implementation and shall comply with Section 5.5.5(A)(2)(e), and the following cover requirements:

(a) Cover RACS with geofabric, followed by eighteen (18) inches of fill suitable for unrestricted use, and vegetation; or

(b) Cover RACS with geofabric, followed by six (6) inches of fill suitable for unrestricted use, and concrete or asphalt; or

(c) Cover RACS with geofabric, followed by fill suitable for unrestricted use to grade or six (6) inches, whichever is greater, for vertical excavation faces or trenches; and

(d) The final grades shall promote surface water run-off and minimize erosion, and shall have slopes no less than 5% (20:1) and no greater than 25% (4:1); or

(e) Alternate cover designs as approved by the Department; and

(f) An environmental covenant, in accordance with 25-15-320, C.R.S., may be required for onsite reuse of RACS.

(2) A plan for beneficial reuse of RACS outside the footprint of the AOC, in

accordance with Section 8.6, shall be submitted to the Department for review and approval prior to its implementation. The plan shall include provisions for covering RACS and shall comply with the management requirements of Section 5.5.5(A)(2)(e). Additionally, the cover requirements outlined in Section 5.5.7(K) shall be adhered to. An environmental covenant, in accordance with 25-15-320 C.R.S. may be required for beneficial reuse of RACS.

(C) Demonstration of Non-RACS

(1) Soil or other matrix material initially determined to be RACS may be demonstrated not to be RACS based on visual inspection, removal of all ACM, and sampling and analysis of the remaining material showing no detectable asbestos. Sampling and analysis shall be conducted in accordance with Appendix 5A. If there is no detectable asbestos, this material is no longer subject to Section 5.5 and may be appropriate for unrestricted use, onsite or offsite, as long as it does not contain any other regulated material.

5.5.9 FEES

The Department shall collect fees, from the owner, operator, or person conducting the soil disturbing activity, based on total documented costs, in accordance with the Regulations Section 1.7

6. CITED REFERENCES –Documents listed below are available upon request

- a. 2013 Soil Characterization and Management Plan for BAFB
- b. “Regulations Pertaining to Solid Waste Sites and Facilities – Asbestos Waste Management,” 6 CCR 1007-2 – Section 5, Hazardous Materials and Waste Management Division, Colorado Department of Public Health and the Environment (CDPHE), July 1, 2007
- c. Appendix 5A of 6 CCR 1007-2 “Sample Collection Protocols and Analytical Methodologies”
- d. Environmental Assessments – Various
- e. Asbestos Survey Reports at Certain Construction Sites, February 2003
- f. Soil Characterization Report Northwest Area – ADF Secure Compound and the Remote Terminal Facility, BAFB, October 2003, Matrix Environmental Services
- g. Site Inspection Report Asbestos Survey for Future Construction Sites, May 2004, URS Group, Inc.
- h. Utility Trench Investigation and Sampling for Asbestos Containing Materials, February 2005, Clayton Group Services
- i. Soil Stockpile Removal Project Report, BAFB, May 2007, US Army Corps of Engineers - – Prepared by Weston Solutions Inc.
- j. CDPHE’s Acceptance Letter of Soil Stockpile Removal Report (Ref Item i. above), 31 Jul 2007.
- k. CDPHE's Closure letter of Compliance Order 03-09-30-01, 16 Mar 11

- l. Pharmacy Asbestos Remediation Final Report, October 2008, US Army Corps of Engineers – Prepared by Weston Solutions Inc.
- m. Soil Characterization and Management Plan North Parking Lot, Building 35, Fitness Center Site Soil Disturbing Activities, Aug 2010, Contract Management, INC and AET Environmental
- n. Closeout Report – Mountainview Operations Facility, BAFB, Aurora CO – Asbestos Contaminated Soil Project Characterization and Management Activities, January 2015 US Army Corps of Engineers – Prepared by SJR Environmental Consulting
- o. BAFB's Installation Development Plan

APPENDIX A

6 CCR 1007-2, Part 1 Sections 1.1, 1.2, and 1.3

This Page Intentionally Left Blank

6 CCR 1007-2**PART 1 - REGULATIONS PERTAINING TO SOLID WASTE SITES AND FACILITIES****SECTION 1.0 ADMINISTRATIVE INFORMATION**

Applicable to all existing or new solid waste facilities.

1.1 GENERAL INFORMATION

1.1.1 Authority These Regulations are promulgated pursuant to the "Solid Wastes Disposal Sites and Facilities Act", Title 30, Article 20, Part 1, Colorado Revised Statutes (CRS), as amended. These Regulations replace and supersede the "Solid Wastes Disposal Sites and Facilities Regulations", adopted February 16, 1972, and effective April 1, 1972.

1.1.2 Referenced materials This document may refer to documents produced by other agencies. All cited references are for that reference that is valid on the particular date of adoption of the pertinent section of these Regulations and do not include later amendments or editions of the incorporated material. Copies of the referenced material may be reviewed during normal business hours at the Colorado Department of Public Health and Environment. Information on accessing the referenced documents may be obtained by contacting the:

Colorado Department of Public Health and Environment
Program Manager
Solid Waste Section
Hazardous Materials and Waste Management Division
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530
Phone: (303) 692-3300

1.2 DEFINITIONS

“Abandoned facility” means facility in operation after the initial enactment of the Solid Waste Disposal Sites and Facilities Act in 1967 that has ceased operations without implementing a closure plan in accordance with the Regulations that were in effect on the date of closure.

“Act” means the "Solid Wastes Disposal Sites and Facilities Act", Title 30, Article 20, Part 1, CRS, as amended.

“Active life” means the period of operation beginning with the initial receipt of solid waste, and ending at completion of closure activities in accordance with these Regulations.

“Active operating area” means an area that includes all areas of unloading, bailing, compacting, storing and out loading.

“Active portion” means that part of a facility or unit that has received or is receiving wastes and that has not been closed in accordance with these Regulations.

“Adequate cover” means:

- (a) Daily cover: At least six inches (6") of earthen material or other suitable material placed over the exposed solid waste at the end of each operating day, or at such frequencies as needed to prevent or minimize nuisance conditions, and
- (b) Intermediate cover: At least one foot (1') of earthen material or other suitable material placed over solid wastes in areas left temporarily unused for at least one month, but not finally closed; and
- (c) Final cover: Final cover design should be selected from alternatives presented in Subsection 3.5.3.

“Adequately wet” means sufficiently wet to minimize visible emissions of dust and/or debris within the regulated work area (RWA) and either:

- (a) Prevent the release of visible emissions from leaving the RWA in accordance with Section 5.5 of these Regulations; or
- (b) Demonstrate that asbestos fibers are not leaving the RWA above risk-based air thresholds.

The observance of visible emissions, outside of the RWA, of dust and/or debris may be an indication that soils are not adequately wet.

“Adjacent Receptor Zone” means an area of uncontrolled access at a distance of 150' or less from the nearest Regulated Work Area (RWA) boundary during active Regulated Asbestos Contaminated Soil (RACS) disturbance. For the purpose of this definition, highways, streets, and roads without sidewalks, where only vehicles are permitted, are considered to be areas of controlled access and therefore not adjacent receptor zones. For the purpose of this definition "vehicle" means a device that is capable of moving itself, or of being moved, from place to place upon wheels, including bicycles and electrical assisted bicycles. For the purpose of this definition, an area for which access is not ordinarily controlled that is closed to the public during

soil disturbing activities in the adjacent RWA is considered to be an area of controlled access and therefore not an adjacent receptor zone.

“Agent of a wholesaler” as used in Sections 10 and 16 of these Regulations mean a person who is authorized by the Wholesaler to act for or in place of the Wholesaler to transact the Wholesaler’s business as it relates to the distribution of new tires, lubricating oil, or new lead-acid batteries to retailers and the transportation of waste tires, used oil, or used lead-acid batteries to a separate Wholesaler engaged in the business of recycling collection.

“Agricultural wastes” means all solid wastes resulting from the raising of crops or animals on land zoned agricultural by local requirements, including animal manures, that are returned to the soils as fertilizer or soil conditioners. In addition, agricultural waste means all carcasses and carcass by-products resulting from any mass livestock mortality that is the result of an all-hazards event or depopulation ordered by the state veterinarian or other appropriately designated authority.

“Air Monitoring Specialist” (“AMS”) means a person trained and certified, in accordance with the requirements of Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B), for the collection of air samples to determine airborne particulate and/or asbestos concentrations.

“Air pollutant” means any fume, smoke, particulate matter, vapor, gas or any combination thereof which is emitted into or otherwise enters the atmosphere. “Air pollutant” includes, but is not limited to, any physical, chemical, biological, radioactive (including source material, special nuclear material, and by-product material) substance or matter. “Air pollutant” does not include water vapor or steam condensate.

“Air pollution” means any detectable concentration of one or more air pollutants in the ambient air that has caused, is causing, or if unabated may cause injury to human, plant or animal life, or injury to property, or which unreasonably interferes with the comfortable enjoyment of life or property.

“Airport” means an airport open to members of the public without prior permission and without restriction, within the physical capabilities of the facility.

“All-hazards event” means the occurrence of any catastrophic event or incident that is either natural, such as a blizzard, fire, flood, tornado, earthquake, or disease outbreak or man-made and that could be of biological, chemical, radiological, nuclear or explosive origin.

“Amended application” means a document which proposes modifications to an existing facility that constitutes a change in operations to that existing site or facility.

“Ancillary equipment” means any device such as, but not limited to, piping, fittings, flanges, valves, and pumps that is used to distribute, meter, or control the flow of material from its point of generation or transport to a storage or treatment tank(s), between material storage and treatment tanks to a point of disposal onsite, or to a point of shipment for disposal off-site.

“Ancillary Worker” means a worker that has not completed the training under Section 5.5.3(A) and (B) of these Regulations.

“Animal material” means any material derived from animal products that are for consumption by humans or animals. The generators of these products include, but are not limited to, agriculture, food manufacturing and processing industries, restaurants, hospitals and food distributors. Animal material does not include manure.

“Antineoplastic” means acts to prevent, inhibit, or halt the growth of a tumor.

“Applicant” for the purposes of Section 10.12 means any person or business seeking a rebate from the Waste Tire End Users Fund.

“Application for a certificate of designation” means all documents, data and drawings which are submitted, for review, by an applicant to a governing body having jurisdiction. The application shall contain the site location, the type of facility, the engineering design and operations report which includes, but is not limited to, geological, hydrological, engineering and operational data for the design, operation, closure and post-closure of the facility. This information shall be prepared in accordance with these Regulations and all local requirements.

“Approved site or facility” means a site or facility for which a certificate of designation has been obtained, pursuant to the Act.

“Aquifer” means a geologic formation, group of formations, portion of a formation or unit capable of yielding significant quantities of ground water of usable quantity to wells or springs.

“Architectural paint” means an interior or exterior architectural coating sold in a container of five gallons or less.

“Area of Contamination” (“AOC”) means a discrete, discernible area of known RACS.

“Areas susceptible to mass movement” means those areas of influence (i.e., areas characterized as having an active or substantial possibility of mass movement) where the movement of earth material at beneath, or adjacent to the facility because of natural or man-induced events, results in the downslope transport of soil and rock material by means of gravitational influence. Areas of mass movement include, but are not limited to, landslides, avalanches, debris slides and flows, soil flexion, block sliding, and rock fall.

“Asbestos” means the asbestiform varieties of serpentinite (chrysotile), riebeckite (crocidolite), amosite (cummingtonite-grunerite), anthophyllite, actinolite and tremolite.

“Asbestos-containing material” (“ACM”) means any material that contains more than one percent (1%) asbestos.

“Asbestos waste” means any asbestos-containing material whether it contains friable or non-friable asbestos, that is not intended for further use. This term includes but is not limited to

asbestos mill tailings, asbestos from pollution control devices, and containers that contain asbestos.

“Asbestos waste disposal area” means an area approved for the disposal of asbestos waste at a solid waste facility, including, but not limited to, a trench or monofill.

“Ash” means the bottom ash, fly ash or air pollution control residues and other residues of the combustion process from the operation of an incinerator or energy recovery facility, including the combustion of any municipal, commercial or industrial solid waste.

“Authorized signature” means the signature of an individual who has authority to sign on behalf of and bind an individual or corporation.

“Autoclave” means a strong, pressurized, steam heated vessel used for sterilization. When used as a verb the term means the process of sterilization accomplished through the use of such a vessel.

“Barrier layer” means a continuous layer of material designed and constructed to restrict horizontal and/or vertical migration of leachate from the facility. A “barrier layer” may contain both manufactured and natural materials. The term is also used in cap construction to prevent fluids from migrating vertically through the cap.

“Base flood” means a flood that has a one percent chance of recurring in any year, or a flood of a magnitude equalled or exceeded once in 100 years, on the average over a significantly long period.

“Beneficial use” means the use of solid waste as an ingredient in a manufacturing process, or as an effective substitute for natural or commercial products, in a manner that does not pose a threat to human health or the environment. Avoidance of processing or disposal cost alone does not constitute beneficial use.

“Beneficial user” means a person who uses solid waste as an ingredient in a manufacturing process or as an effective substitute for natural or commercial products, in a manner that does not pose a threat to human health or the environment. Avoidance of processing or disposal cost alone does not constitute beneficial use.

“Biohazardous waste” means solid waste containing or contaminated with organisms or viruses infectious to humans, animals or plants (e.g. parasites, viruses, bacteria, fungi, prions, or rickettsia).

“Biosolids” means the accumulated residual product resulting from a domestic wastewater treatment works. Biosolids does not include grit or screenings from a wastewater treatment works, commercial or industrial sludges (regardless of whether the sludges are combined with domestic sewage), sludge generated during treatment of drinking water, or domestic or industrial septage.

“Bird hazard” means an increase in the likelihood of bird/aircraft collisions that may cause damage to the aircraft or injuries to its occupants.

“Blood and body fluids” means all waste unabsorbed human and animal blood or blood products, components of blood or blood products, and other body fluids. Includes, but is not limited to, human blood; plasma; serum; platelets; other blood components and blood products; body fluids including exudates, semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, peritoneal fluid, pericardial fluid and amniotic fluid; suction and irrigation fluids contaminated with blood or body fluids; liquid residues or contaminated water resulting from the cleanup of a spill of medical waste; tattoo ink contaminated or potentially contaminated with blood or body fluids; and blood and body fluids from animals known to be infected with diseases that are contagious to humans. For purposes of this Part 13, it does not include saliva, nasal secretions, sweat, tears, or urine, feces, or vomitus unrelated to isolation wastes unless visible blood is present.

“Buffings” means the residual rubber material removed from the supporting structure of a waste tire or a retreaded or recapped tire.

“Cash plus marketable securities” means all the cash plus marketable securities held by the local government on the last day of the fiscal year, excluding cash and marketable securities designated to satisfy past obligations such as pensions.

“Certificate of designation” means a document issued by the governing body having jurisdiction to a person authorizing the use of land for a solid waste disposal site and facility pursuant to the Act. The "certificate of designation", which incorporates all information as may be required by the Department and the governing body having jurisdiction, is then issued by the governing body having jurisdiction if the Department has determined that the minimum standards are met.

“Certified Asbestos Building Inspector” (“CABI”) means a person trained and certified in accordance with Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B), for the identification of asbestos-containing materials and the collection of samples to determine asbestos content, including qualified Department personnel.

“Closed facility” means a solid waste site or facility that has been closed in accordance with provisions of the federal Regulations pursuant to Subtitle D of the federal "Resource Conservation and Recovery Act of 1976", as amended, as published in 40 CFR Part 258.60 or in the manner specified in the approved certificate of designation application at the time of approval of the site or facility, or in a closure plan that has been approved by the Department or prior to the enactment of the Solid Waste Disposal Sites and Facilities Act (C.R.S. 30-20-100.5).

“Collect” as used in Sections 18 of these Regulations means to gather or acquire waste grease from sources of waste grease; except that “collect” does not include moving waste grease from one area or container to another area or container on the same premises.

“Collection facility” as used in Section 16 of these Regulations means any facility that accepts, aggregates and stores used oil, used lead-acid batteries, or waste electronic devices generated elsewhere for transport to a location described in Sections 16.2, 16.3, 16.4, and 16.5 of these Regulations.

“Collect water volume” means to provide storage in channels or basins to allow for controlled discharge.

“Commercial wastes” means all solid wastes generated by stores, hotels, markets, offices, restaurants, warehouses, and other non-manufacturing activities, excluding community and industrial wastes.

“Commission” means the solid and hazardous waste commission created in section 25-15-302, C.R.S.

“Community wastes” means all solid wastes generated by the noncommercial and nonindustrial activities of private individuals, including solid wastes from households, yards, streets, sidewalks and alleys.

“Composite liner” means a liner system consisting of two components: the upper component shall consist of a flexible membrane liner (FML) and the lower component shall consist of a compacted soil layer. The FML component must be installed in direct and uniform contact with the compacted soil component.

“Compost” means the material or product which is developed under controlled conditions and which results from biological degradation processes by which organic wastes decompose.

“Compost facility” means a site where compost is produced.

“Compost Feedstock” or **“Feedstock”** means any decomposable organic material used in the production of compost or chipped and ground material including, but not limited to, green wastes, animal material, manure, biosolids, and solid waste.

“Composting” means the biological process of degrading organic materials that is facilitated and controlled through intentional and active manipulation of piles and windrows. These manipulations may include but are not limited to grinding, mixing of feed stocks and bulking materials, addition of liquids, turning of piles, or mechanical manipulation.

“Construction and demolition debris” means waste that is generated from construction, remodeling, repairs, or demolition of buildings, pavements, and other structures which includes but is not limited to, lumber, bricks, carpets, ceramics, sheetrock, metals, drywall, window glass, metal and plastic piping, paint and any other non-hazardous materials resulting from construction and demolition operations.

“Construction and demolition debris facility” means a discrete area of land or an excavation which is designed for the final disposal of solid waste which result from the construction or demolition of a building or structure, such as lumber, bricks, concrete, sheetrock and other similar materials.

“Consumer” as used in Section 16 of these Regulations means a person who has purchased an electronic device primarily for personal or home business use.

“Consumer product” as used in Section 16 of these Regulations means any device that is primarily intended for personal or household use and is typically sold, distributed, or made available to the general population through retail or mail-order distribution. Such term does not include vehicles, motorcycles, wheelchairs, boats, or other forms of motive power. The term does include, but is not limited to, computers, games, telephones, radios, and similar electronic devices.

“Control water volume” means to discharge at a rate that will not exceed the discharge rate of historic flows at the discharge point or at an appropriate point in the receiving stream.

“Custom mill” means an operation or facility for the extraction of metals or minerals from ores. Such a facility receives its raw materials from one or more sources off-site of the mill property.

“Daily cover” means using tire-derived product as an alternate cover placed upon exposed solid waste in a permitted solid waste facility to control disease vectors, fires, odors, blowing litter and scavenging, without presenting a threat to human health or the environment.

“Debris” means any discarded material that contains or consists of any of the following: construction, renovation and demolition debris (regardless of how it was generated), building or facility components, components of building systems (HVAC, plumbing, electrical, control, fire protection, roofing), components of pavement or drainage systems, industrial or machinery components, and/or mechanical components from motorized vehicles.

“Debt service” means the amount of principal and interest due on a loan in a given time period, typically the current year.

“Deficit” means the total annual revenues minus total annual expenditures.

“De minimis quantities of used oil” as used in Section 16 of these Regulations means small spills, leaks, or drippings from pumps, machinery, pipes, and other similar equipment during normal operations; except that the term shall not include used oil discarded as a result of abnormal operations resulting in substantial leaks, spills, or other releases.

“Department” means the Colorado Department of Public Health and Environment.

“Dewatered” means that the material has been subjected to a process that will remove free moisture from the material as determined by the paint filter test.

“Disease vector” means any animal, insect, bacterium or virus capable of transmitting disease, illness or harm to humans.

“Do-It-Yourselfer (DIY)” as used in Section 16 of these Regulations means an individual who residentially generates “do-it-yourselfer” used oil.

“Do-It-Yourselfer used oil collection center” as used in Section 16 of these Regulations means any site or facility that accepts, aggregates and stores residentially generated used oil collected only from do-it-yourselfers.

“Drop-off site” means a recycling consolidation site with no on-site processing; only collection of materials in a bin, roll-off, or other type of container.

“Dry Weight Basis” means weight calculated on the basis of material having been dried until reaching a constant mass, resulting in essentially a 100 percent solids content.

“Electronic Device” means a device that is marketed by a manufacturer for use by a consumer and that is a computer, peripheral, printer, facsimile machine, digital video disc players, video cassette recorder, or other electronic device specified by rule promulgated by the commission; or a video display device or computer monitor including a laptop, notebook, ultrabook, or netbook computer, television, tablet, or slate computer, electronic book, or other electronic device specified by rule promulgated by the commission that contains a cathode ray tube or flat panel screen with a screen size that is greater than four inches, measured diagonally. “Electronic device” does not include a device that is part of a motor vehicle or any component part of a motor vehicle, including replacement parts for use in a motor vehicle; a device, including a touch-screen display, that is functionally or physically part of or connected to a system or equipment designed and intended for use in any of the following settings, including diagnostic, monitoring, or control equipment: industrial; commercial, including retail; library checkout; traffic control; security, sensing, monitor, or counterterrorism; border control; medical; or governmental or research and development; a clothes washer or dryer; a refrigerator, freezer, or refrigerator and freezer; a microwave oven or conventional oven or range; a dishwasher, a room air conditioner, dehumidifier, or air purifier; or exercise equipment; a device capable or using commercial mobile radio service, as defined in 47 CFR 20.3, that does not contain a video display area greater than four inches, measured diagonally; or a telephone.

“Emergency” means an unexpected situation or sudden occurrence of a serious and urgent nature that demands immediate action and that constitutes a threat to life or health, or that may cause major damage to property.

“Emission” means the discharge or release into the atmosphere of one or more air pollutants.

“Empty container” means a container or inner liner removed from a container that has been emptied by the generator as much as possible using methods commonly used to remove waste or material from containers (e.g., if the material was pourable, then no material can be poured or drained from the container; if the material was not pourable, then no material can reasonably be removed by scraping). In the case of a container that held an acute hazardous waste, the container is considered empty when the container or inner liner has been triple

rinsed using a solvent capable of removing the product, the container or inner liner has been cleaned by another method that has been shown to achieve equivalent removal, or the inner liner that prevented contact of the product with the container has been removed.

“Encapsulation” means coating the surface of a solid waste with material such as resins or plastics to substantially reduce the amount of soluble, miscible or suspended contaminants leached from the waste.

“End User” means a person who uses a tire-derived product for a commercial or industrial purpose.

“End User” means a person who:

- (a) Uses a tire-derived product for a commercial or industrial purpose;
- (b) Uses a whole waste tire to generate energy or fuel; or
- (c) Consumes tire-derived product or uses tire-derived product in its final application or in making new materials with a demonstrated sale to a third party customer.

"Engineering design" means the analysis and design work prepared for construction, operation and closure of a solid waste disposal site or facility which may contain a preliminary report of design specifications, maps and plans drawn to a convenient and common scale, provides site or facility operation plans and site or facility closure plans, and contains all information and data otherwise specified by these Regulations.

“Environmental Media” means earth materials including soil, sand, silt, gravel, rock, stone, sediment, and other naturally occurring solids.

“EP waste disposal facility” means a commercial solid wastes disposal site and facility that accepts the deposit of EP waste.

“Excluded scrap metal” means processed scrap metal, unprocessed home scrap metal, and unprocessed prompt scrap metal.

“Exemption” means, for the purposes of these Regulations, that a facility shall be free or largely free of some permitting obligation as specifically provided in the Colorado Revised Statutes, 30-20-102.

“Existing landfill” means any landfill that has received solid waste as of the effective date of these regulation.

“Exploration and production waste” or “EP waste” means exploration and production waste, as that term is defined in section 34-60-103, C.R.S. EP waste is currently defined as wastes that are generated during the drilling of and production from oil and gas wells or during primary field operations and that are exempt from regulation as hazardous wastes under subtitle C of the federal "Resource Conservation and Recovery Act of 1976", 42 U.S.C. sec. 6901 to 6934, as amended.

“Explosive gas” means methane or other combustible gases, generated by decomposition in a facility for solid wastes disposal.

“Facility or solid waste disposal facility” means all contiguous land and structures, other appurtenances, and improvements on the land used for solid waste disposal.

“Facility component” for purposes of Section 5.5, means any part of a facility including equipment. For the purpose of this definition, “facility” means (as defined in Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B):

“any institutional, commercial, public, industrial, or residential structure, installation, or building (including any structure, installation, or building containing condominiums or individual dwelling units operated as a residential cooperative, but excluding: residential buildings having four or fewer dwelling units); any ship; and any active or inactive waste disposal site. For purposes of the definition, any building, structure, or installation that contains a loft used as a dwelling is not considered a residential structure, installation, or building. Any structure, installation or building that was previously subject to this subpart is not excluded, regardless of its current use or function.”

“Facility structures” means any building, structure, or utility services trenches, temporary or permanent, at a facility for solid wastes disposal.

“Fault” means a fracture or a zone of fractures in any material along which strata on one side have been displaced with respect to strata on the other side.

“Fault displacement” means the relative movement of any two sides of a fault measured in any direction.

“Favorable geologic conditions” means that a site selection shall emphasize tight soils, distance from ground water, deep aquifers and similar natural features.

“Floodplain” means lowland areas adjacent to inland surface waters that are inundated by the base flood.

“Friable asbestos-containing material” (“Friable ACM”) means any material that contains asbestos and when dry can be crumbled, pulverized, or reduced to powder by hand pressure and that contains more than one percent asbestos by weight, area, or volume. The term includes non-friable forms of asbestos after such previously non-friable material becomes damaged to the extent that when dry it can be crumbled, pulverized, or reduced to powder by hand pressure as determined in the field by a CABI.

“Friable asbestos waste” means any asbestos waste that has been or can be pulverized or reduced to powder by hand pressure when dry.

“Gas condensate” means the liquid generated as a result of gas recovery process[es].

“Geofabric” for the purposes of Section 5.5 means a permeable fabric or synthetic material used for both visual and physical separation.

“Good faith effort” means the required actions for a county to perform and document before the county commissioners may vote to exempt itself from the residentially generated electronic waste landfill ban.

“Governing body having jurisdiction” means the board of county commissioners if a site and facility is located in any unincorporated portion of a county and means the governing body of the appropriate municipality if a site and facility is located within an incorporated area.

“Green Waste” means any plant material that is either separated at the point of generation, or separated at a centralized facility. Green waste includes, but is not limited to, yard trimmings, plant wastes from the food processing industry, untreated wood wastes, paper products and pre-consumer vegetative food waste.

“Ground water” means any water below the land surface in a zone of saturation.

“Ground water protection standard” means those standards established by following 40 CFR 258.55(H) and (I) methodology or standards established by this Department (5 CCR 1002-8).

“Hazardous constituent” means the list of chemical parameters described in Appendix IB and II of these Regulations and 6 CCR 1007-3, Part 261.3 Appendix VIII.

“Hazardous waste” means those substances and materials defined or classified as such by the Hazardous Waste Commission pursuant to 25-15-302, C.R.S., as amended.

“Health departments” means the Colorado Department of Public Health and Environment and a local health department if such entity exists.

“High wind warning” means that sustained winds of forty miles per hour (40 MPH) or greater, or gust of fifty-five miles per hour (55 MPH) or greater, are expected to persist for one hour or longer, as defined by the National Weather Service.

“Holocene” means the most recent epoch of the quaternary period, extending from the end of the pleistocene epoch to the present.

“Home scrap metal” means scrap metal generated by steel mills, foundries, and refineries, including, but not limited to, turnings, cuttings, punchings, and borings.

“Household medical waste” means any medical waste generated by households. Does not include medical waste generated at health and residential care facilities regulated under the Standards for Hospitals and Health Facilities (6 CCR 1011-1).

“Household waste” means any solid waste generated by households, including single and multiple residences, and motels, bunkhouses, ranger stations, crew quarters, campgrounds, picnic grounds, and day-use recreation areas.

“Incineration” means the combustion of solid wastes in such a way as to:

- (a) Control the air mixture to maintain adequate temperature for efficient combustion; and
- (b) Contain the combustion reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion; and
- (c) Control the emission of combustion byproducts consistent with the standards, rules and Regulations promulgated by the Department's Air Quality Control Commission.

“Incompatible wastes” means wastes which, when mixed, produce heat, pressure, fire, explosion, violent reaction, toxic mist, fumes or gases, or flammable fumes or gases.

“Incorporated into the soil” means the insertion of solid waste beneath the surface of soil or the mixing of solid wastes with the surface soil.

“Industrial recycling operation” means any site and facility operated for the purpose of processing, reclaiming, sorting, and recycling recyclable materials generated from industrial operations which includes but is not limited to construction and demolition debris, and other recyclable materials as determined by the Department.

“Industrial wastes” means all solid wastes, including mill tailings and mining wastes, resulting from the manufacture of products or goods by mechanical or chemical processes that are not a hazardous waste regulated under 6 CCR 1007- 3, the Colorado Hazardous Waste Regulations. Such waste may include, but is not limited to, construction and demolition debris, and waste resulting from the following manufacturing processes: electric power generation; fertilizer/agricultural chemicals; food and related products/by products; inorganic chemicals; iron and steel manufacturing; leather and leather products; nonferrous metals manufacturing/foundries; organic chemicals; plastics and resins manufacturing; pulp and paper industry; rubber and miscellaneous plastic products; stone, glass, clay, and concrete products; textile manufacturing; transportation equipment; and water treatment. This term does not include oil and gas wastes regulated by the Colorado Oil and Gas Conservation Commission.

“Inert material” means non-watersoluble and non-putrescible solids together with such minor amounts and types of other materials as will not significantly affect the inert nature of such solids. The term includes, but is not limited to, earth, sand, gravel rock, concrete which has been in a hardened state for at least sixty days, masonry, asphalt paving fragments, and other inert solids.

“Inert material facility” means a site and facility that accepts for disposal exclusively those materials defined herein as inert material.

“Infectious waste” means waste containing pathogens or biologically active material which

because of its type, concentration and quantity could present a potential hazard to human health when improperly handled, stored, processed, transported or disposed of. Wastes presumed to be infectious medical waste include blood and body fluids, potentially infectious waste, pathological waste, sharps, trauma scene waste, and any additional waste determined to pose a sufficient risk of infectiousness as determined by the Department on a case-by-case basis. This also includes any residue or contaminated soil, water, or other debris resulting from the cleanup of a spill of any infectious medical waste. For purposes of these Regulations, it does not include saliva, nasal secretions, sweat, tears, used feminine hygiene products, vomitus, urine or feces unrelated to isolation wastes, uncontaminated disposable bedding or garments, or lightly to moderately contaminated bandages, garments, etc. unless these wastes are soiled to the extent that the generator of the waste determines that they should be managed as infectious waste. Such wastes remain regulated under the provisions of Parts 1 through 3 of these Regulations.

“Intermediate processing facility” means a facility designed to remove recyclables from unprocessed municipal solid waste, commonly referred to as a Dirty-MRF.

“Isolation waste” means contaminated material from humans or animals that are isolated because they are suspected or known to be infected with an infectious agent capable of causing a highly communicable, possibly lethal disease. National biosafety guidelines developed by agencies such as the U.S. Department of Health and Human Services, National Institutes of Health or the Centers for Disease Control and other medical professionals should be referenced when making this determination.

“Karst terrains” means areas that are characterized by surface and subterranean features, and that are developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terrains include, but are not limited to sinkholes, sinking streams, caves, large springs, and blind valleys.

“Land application facility” means an area where solid wastes are applied onto or incorporated into the soil surface for the purposes of biological degradation, treatment, final disposal, or beneficial purposes.

“Land disposal” as used in Section 16 of these Regulations means placing, discarding, or otherwise disposing of residentially generated solid wastes:

- (a) In any solid wastes disposal site and facility, transfer station, or treatment, storage or disposal facility operated by the state, a local government, or a private entity;
- (b) In sewers, drainage systems, septic tanks, surface or ground waters, watercourses, or any body of water; or
- (c) On the ground.

“Landfill” means a discrete area of land or an excavation where solid wastes are placed for final disposal, which is not a land application unit, waste impoundment, or waste pile. Landfills include, but are not limited to, ash monofills, construction and demolition landfills, industrial landfills, sanitary landfills, tire monofills and similar facilities where final disposal occurs.

“Landfill phase” means a subpart of a landfill.

“Lateral expansion” means any horizontal expansion of previously approved waste management unit boundaries for which the Department has not approved as-built construction documents.

“Leachate” means liquid that has passed through or had contact with solid wastes and may contain soluble, miscible, or suspended constituents removed from the wastes.

“Lead-acid battery” as used in Section 16 of these Regulations means a battery that:

- (a) Consists of lead and sulfuric acid;
- (b) Is used as a power source; and
- (c) Is not intended as a power source for consumer products.

“Leak tight” means that solids, liquids, or gases cannot escape or spill out. It also means dust tight.

“Liner” means a continuous layer of natural or man-made materials beneath and on the sides of a waste impoundment or landfill which restricts or prevents the downward or lateral escape of solid waste, its constituents, or leachate. A liner is also used in cap construction to prevent and control vertical movement of fluids.

“Liquid waste” means any waste material that is determined to contain “free liquid”.

“Lithified earthen material” means all rock, including all naturally occurring and naturally formed aggregates or masses of minerals or small particles of older rock that formed by crystallization of magma or by induration of loose sediments. This term does not include man-made materials, such as fill, concrete, and asphalt, or unconsolidated earthen materials, soil, or regolith lying at or near the earth surface.

“Local governing authority” means the governing body having jurisdiction.

“Local requirements” means all zoning, laws, resolutions or ordinances related to or enforced on solid waste disposal promulgated by counties, municipalities or other political subdivisions of the state and the specifications and requirements identified as part of a certificate of designation.

“Low Emissions Methods” means soil disturbing activities that will not result in visible emissions without the use of wet methods.

“Lower explosive limit” means the lowest percent, by volume, of a mixture of explosive gas or gases in air that will propagate a flame at 25°C (77°F) and at standard atmospheric pressure.

“Lubricating oil” as used in Section 16 of these Regulations means the fraction of crude oil

or synthetic oil used to reduce friction in motorized equipment. “Lubricating oil” includes rerefined oil.

“Management” means the handling, storage, collection, transportation and disposal of solid waste.

“Manifest” as used in Section 18 of these Regulations means the document for identifying the quantity, composition, origin, routing, and destination of waste grease during its transportation from the point of generation to the point of storage, treatment, or disposal.

“Manure” means accumulated animal excrement. This includes feces and urine, as well as any bedding material, spilled feed, or soil that is mixed with feces or urine.

“Material recovery facility (MRF)” means a facility consisting of structures, machinery, devices, or persons to sort, bale, or otherwise manage or process source separated recyclable materials prior to conveyance to end markets.

“Maximum horizontal acceleration in lithified earth material” means: (1) The maximum expected horizontal acceleration depicted on a seismic hazard map, with a 90 percent or greater probability that the acceleration will not be exceeded in 250 years; or (2) The maximum expected horizontal acceleration based on a site-specific seismic risk assessment.

“Mechanical” means operated or produced by mechanism, tool or machine.

“Medical Waste” means any infectious, pharmaceutical or trace chemotherapy waste generated in a health care setting in the diagnosis, treatment, immunization, or care of humans or animals; generated in autopsy or necropsy; generated during preparation of a body for final disposition such as cremation or interment, generated in research pertaining to the production or testing of microbiologicals; generated in research using human or animal pathogens; or related to accident, suicide, or other physical trauma. Medical waste does not include fluids, tissues or body parts removed from the whole body for the purposes of donation, research or other use, or those returned to the person from whom they were removed, or their authorized representative, as long as the material is rendered safe for handling. For purposes of these Regulations, this does not include medications reused in compliance with 6 CCR 1011-1 Chapter II Part 7.200 et. seq. or 6 CCR 1015-10.

“Medical waste generator” means any person, as defined in these Regulations, whose act or process produces medical waste. This includes, but is not limited to, generators at hospitals, clinics (such as medical, dental and veterinary), surgery centers, dialysis centers, blood banks, long term care facilities, hospices, funeral homes, laboratories (such as clinical, diagnostic, pathological, veterinary and biomedical research), pharmacies, body art establishments (such as where body piercing, tattooing, branding, sculpting and scarification are performed), acupuncture facilities, trauma scene cleanup sites, facilities holding shot clinics or health fairs, other health-related facilities or events, educational and research facilities, and pet shops.

“Medical Waste Management Plan” means a document that must be developed and

implemented by medical waste generators that designates all of the medical wastes generated by the facility, waste handling techniques to be used at the facility, contingency plans for spills or releases, staff training requirements, and designation of the person responsible for implementation of the management plan.

“Medical waste treatment” means any validated method, technique, or process designed to change the biological character or composition of a medical waste so as to minimize its potential to harm human health or the environment.

“Mill tailings” means an industrial solid waste generated by the mechanical or chemical processing of minerals for subsequent conversion into useable forms such as a metal, a metallic compound, an energy source, or raw material for manufacture.

“Minimum access” means the lack of infrastructure within a county as specified in Section 16 that would result in a county being able to pursue an exemption from the residentially generated electronics waste landfill ban.

“Mining waste” means overburden to be discarded and other industrial wastes directly related to the preparation, development and operation of mineral extraction facilities. Mining waste includes only waste material directly connected with the cleaning and preparation of substances mined by an operation are managed at the mine site where they are generated.

“Mobile Processor” means a person who processes waste tires at a location other than the location of the person’s certificate of registration.

“Monofill” means a landfill or section of landfill at which only one type of waste is accepted for disposal.

“Motor vehicle” means a self-propelled vehicle that is designed for travel on the public highways and that is generally and commonly used to transport persons and property over the public highways or a low speed electric vehicle. “Motor vehicle” includes automobiles, minivans, all trucks, motor homes, and motorcycles.

“Municipal solid waste” means solid waste from household, community, commercial and industrial sources that does not contain hazardous wastes as defined in Section 25-15-101(9) of the Colorado Hazardous Waste Act unless otherwise regulated by the Department.

“Municipal solid waste landfill (MSWLF)” means a sanitary landfill where one of the main waste streams accepted is municipal waste.

“Municipal solid waste incinerator ash” means the bottom ash, fly ash or air pollution control residues and other residuals of the combustion process from the operation of incinerator or energy recovery facilities managing municipal solid waste.

“Municipality” means a home rule or statutory city, town, or city and county, or territorial

charter city.

“National Priorities List (NPL)” means the list, compiled by the U.S. Environmental Protection Agency pursuant to section 105 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C.

§ 9605, of uncontrolled hazardous substance releases in the United States that are priorities for long-term remedial evaluation and response. For the purposes of this regulation, this term also includes sites that have been deleted from the NPL following completion of the cleanup, but for which there are required, ongoing operation and maintenance activities (including the implementation of institutional controls).

“Noise pollution” means sound levels radiating from the site boundary, at a distance of twenty-five feet (25') or more, in excess of standards established in Sections 101 and 103 of the "Colorado Noise Abatement Act", Title 25, Article 12, Part 1, CRS, as amended.

“Noncommercial burning of trash” means the combustion of solid wastes in accordance with CRS 30-20-110 of the Act.

“Nonfriable asbestos waste” means any asbestos waste other than friable asbestos waste.

“Non-Regulated Asbestos Contaminated Soil” (“Non-RACS”) means soil or debris that contains only:

- 1) Intact non-damaged, non-friable asbestos-containing materials (ACM); or,
- 2) Damaged non-friable ACM(s) that do not have a high probability to release fibers based on the forces expected to act upon the material during disturbance as determined in the field by a CABI(s) through a “RACS Determination”. The following ACM(s) are predetermined to be Non- RACS:
 - a. Resin based materials including but not limited to phenolic-plastic (Bakelite), used in electrical and mechanical parts
 - b. Resilient flooring (vinyl, asphalt, rubber) excluding non-tar impregnated friable felt backing on sheet vinyl flooring (linoleum)
 - c. Tar impregnated or asphaltic materials in good condition that have not become brittle
 - d. Elastic, pliable, or rubberized materials, including but not limited to:
 - i. Pliable duct sealant
 - ii. Pliable fiberglass insulation sealant
 - iii. Pliable fire-stop caulking /sealants
 - iv. Pliable window and door caulking
 - e. Extremely hard materials, coatings and sealants including but not limited to:
 - i. Laboratory countertops and sinks
 - ii. Epoxy type Concrete Masonry Unit (CMU) coatings
 - iii. Epoxy type panel adhesive
 - iv. Duct sealant
 - v. Ceiling tile adhesive

- f. Other ACM(s) as approved by the Department at the request of the owner or person disturbing debris, to not have a high probability to release fibers.

“Nuisance conditions” are those which may result from explosive gas, bird hazards, disease vectors, odors, windblown solid wastes or cover materials, open burning, water pollution, air pollution, noise pollution and traffic congestion.

“On-site recycling” means recycling operations where the processing of recyclable materials occurs on the same site or under the same ownership from where the recyclable materials are generated and that recycle and store only materials generated on site or under continuous ownership and meet the performance standards set forth in Section 8.

“Open burning” means the uncontrolled or unconfined combustion of solid wastes at a facility for solid waste disposal without the following: Control of combustion air to maintain adequate temperature for efficient combustion; containment of the combustion reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion; and control of the emission of the combustion products.

“Operator” means the person(s) responsible for the overall operation of a facility or part of a facility.

“Other Compatible Materials” means the minimum quantity of materials necessary to achieve and maintain an appropriate porosity, moisture level or carbon to nitrogen (C:N) ratio for proper composting. Such materials are limited to Type 1 feedstocks as defined in Subsection 14.1.4 of these Regulations, or other materials approved by the Department and governing body.

“Owner” means the person(s) who owns a facility or part of a facility.

“Paint producer” means an original producer of architectural paint that sells, offers for sale, or distributes architectural paint within or into Colorado under either the producer’s own name or a brand that the producer manufactures.

“Paint stewardship organization” means a corporation, nonprofit organization, or other legal entity created or contracted by one or more producers to implement a paint stewardship program.

“Paint stewardship program” means a program created in accordance with Section 25-17-405 C.R.S.

“Pathogens” means disease-causing organisms.

“Pathological waste” means all tissues, organs, limbs, products of conception, and other body parts removed from the whole body. Includes, but is not limited to, tissues; organs; body parts

removed during surgery, autopsy or other medical procedures; and human anatomical remains. Also includes contaminated animal tissue (including animal carcasses and body parts) from animals known to have been exposed to infectious substances during research, production of biologicals, testing of pharmaceuticals, or other exposures and those known or suspected of being contaminated with infectious substances known to be contagious to humans. This does not include contaminated animal waste that is regulated under Section 14 of these Regulations.

“Peripheral” as used in Section 16 of these Regulations means a keyboard, mouse, or other device that is sold exclusively for external use with a computer and provides input or output into or from a computer.

“Person” means an individual, partnership, private or municipal corporation, firm, board of metropolitan district or other sanitation district, or other association of persons.

“Person” as used in Section 16 of these Regulations means an individual. “Person” shall not include waste haulers, as defined in this Section.

“Personal use of waste grease as biofuel” means that the person collecting or transporting the waste grease intends to use the waste grease as biofuel.

“Personal use of waste grease other than for use as biofuel” means that the person collecting or transporting the waste grease intends to use the waste grease for some other purpose than biofuel.

“Pharmaceutical” means any prescription or over-the-counter chemical product, vaccine or allergenic that is intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease in humans or animals. This includes, but is not limited to, drugs, pills or tablets; medicinal gums or lozenges; medicinal liquids, ointments and lotions; intravenous (IV) or other compounded solutions; live vaccines; non-hazardous attenuated vaccines; allergenics; medicinal shampoos; antiseptics; medicinal dermal patches; and any delivery devices with the primary purpose to deliver or dispense a medicinal chemical product, vaccine or allergenic.

“Pilot” or “Pilot Project” means a restricted composting operation at an existing or new facility where the specific purpose is to investigate an alternative feedstock or to research operational methods.

“Point of compliance” as referred to in Section 2.2, 3.2.5 and 3.5 shall be located on land owned by the owner of the site and facility and means either:

- (1) For a landfill, a vertical surface which is not more than 150 meters from the waste management unit boundary as described in the engineering design and operations report; or
- (2) For other sites and facilities a vertical surface that is at the perimeter of the solid waste disposal site and facility boundary.

“Poor foundation conditions” means those areas where geological features exist which indicate that a natural or man-induced event may result in inadequate foundation support for the structural components of the facility.

“Potentially infectious waste” means any waste known or suspected to be contaminated with a transmissible infectious agent potentially capable of causing disease or injury. Includes, but is not limited to, cultures and stocks from pathological, medical, research, and industrial laboratories; wastes from the production of biologicals; devices used to transfer, inoculate, and mix cultures; isolation wastes; biohazardous waste, contaminated animal bedding from animals known to have been exposed to infectious substances during research, production of biologicals, testing of pharmaceuticals, or other exposures and those known or suspected of being contaminated with infectious substances known to be contagious to humans. This category also includes items that are capable of releasing blood or body fluids in any form during handling or storage and items that are caked with dried blood or body fluids that could be released during handling or storage; wastes from surgery, autopsy or other medical or laboratory procedures such as visibly contaminated sponges, soiled dressings, drapes, surgical gloves, drainage sets, and dialysis wastes in contact with blood; unbroken blood vials, drainage sets, dialysis wastes, suction canisters, hemovacs, or IV bags and tubing (without needle attached) containing blood or body fluids. This does not include contaminated animal bedding that is regulated under Section 14 of these Regulations.

“Practicable solid waste management alternative” means a materials or resource recovery facility, transfer station or any other alternative to the existing landfill, which the owner or operator has determined will, if utilized as an alternate disposal site to solid waste management alternative:

- (1) Increase customer's cost for solid waste management services by less than 100%;
- or
- (2) Not result in a solid waste management cost to the local government owner or operator which exceeds one percent of that local government's total annual budget.

“Preliminary report” means an initial report prepared by qualified professionals, including geologists, land surveyors, ground water specialists, engineers and others which contains technical information regarding geologic, engineering and hydrologic data and site information, and other data which the Department deems necessary.

“Process” means any physical, chemical, or biological treatment that is performed to make the waste grease more available for recycling or reuse, reduced for volume or toxicity, or produces a final residual material that is suitable for disposal. “Process” does not include the filtering of waste grease where such filtering takes place in an enclosed grease trap fitter with mechanisms for such filtering.

“Processed scrap metal” means scrap metal that has been manually or physically altered to separate it into distinct materials to enhance economic value or to improve the handling of materials. Processed scrap metal includes, but is not limited to:

- (a) Scrap metal that has been baled, shredded, sheared, chopped, crushed, flattened, cut, melted, or separated by metal type; and
- (b) Fines, drosses, and related materials that have been agglomerated.

“Processed Solid Waste” means the material from a post collection solid waste stream that has been separated for use in the composting process.

“Processing” means performing operations to solid waste and recyclable materials that allows for the purpose of proper solid waste disposal, recycling, composting, or incineration including but not limited to the operations of separating material by type, grade or color, sorting, crushing, grinding, shredding, baling, removing contaminants and modifying material properties.

"Product" means the material or the good generated as a result of processing source separated recyclable materials for which no further processing is required prior to final utilization.

"Project" means any soil disturbing activity that involves Regulated Asbestos Contaminated Soil (RACS) within a planned geographic area(s) of disturbance, as defined in the Notification of RACS Disturbance form submitted for that specific management or remediation scope, starting from the time of first RACS disturbance and continuing through final RACS removal or stabilization and final demobilization. A project may include one or more Regulated Work Areas (RWAs), and start dates and stabilization dates for individual RWAs within a project may be different.

“Project Specific RACS Management Plan” (“PSRMP”) means a Regulated Asbestos Contaminated Soil (RACS) management plan for a single project submitted in accordance with Section 5.5.5(A).

“Prompt scrap metal” means scrap metal generated by the metal working or fabrication industries, including, but not limited to, turnings, cuttings, punchings, and borings. “Prompt scrap metal” includes industrial metal scrap and new scrap metal.

“Public project” means:

- (a) A publicly funded contract entered into by a governmental body of the executive branch of this state that is subject to the “Procurement Code”, articles 101 to 112 of title 24, C.R.S.; and
- (b) A publicly funded contract entered into by a county, municipal government, or special district, including a school district or recreation district.

“Putrescible wastes” means those solid wastes that contain organic matter capable of being decomposed by microorganisms, and of such a character and proportion as to be capable of attracting or providing food for birds or disease vectors.

"Pyrolysis" means the thermochemical decomposition of material at elevated temperatures without the participation of oxygen.

“Qualified ground water scientist” is a scientist or engineer who has received a baccalaureate or post-graduate degree in the natural sciences or engineering and has sufficient training and

experience in ground water hydrology, and related fields as may be demonstrated by state registration, professional certifications, professional experience or completion of accredited university programs that enable that individual to make sound professional judgements regarding ground water monitoring, contaminant fate and transport, and corrective action.

“Qualified Project Monitor” (“QPM”) means an individual who has the training and/or experience necessary to identify materials suspected of containing asbestos and who has the authority to make prompt decisions relating to the management of such materials, and who meets the training requirements in Section 5.5.3.

“Recapped or retreaded tire” means a previously worn tire which has gone through a remanufacturing process designed to extend its useful service life.

“Recyclable materials” means any type of discarded or waste material that is not regulated under Section 25-8-205(1)(e), C.R.S., and can be reused, remanufactured, reclaimed, or recycled but not including recycled auto parts or excluded scrap metal that is being recycled, or scrap that is composed of worn out metal or metal product that has outlived its original use, commonly referred to as obsolete scrap.

“Recyclable material end user” includes all manufacturing operations that perform processing of municipal solid waste recyclable materials to be utilized as a raw material for fabrication of a product for normal business operations.

“Recyclable material generator” includes any business or institution that annually generates and consolidates over 100 tons of municipal solid waste recyclable material and ships directly to end markets or processing facilities out of state for recycling.

“Recycling facility” means a separate facility, or a part of a solid waste disposal facility, where recycling operations are conducted.

“Registrant” as used in Section 18 of these Regulations means a person registered under Section 18.

“Regulated Asbestos Contaminated Soil” (“RACS”) means soil, ash or debris (plus six (6) inches in all directions of surrounding soil or other matrix material) containing:

- 1) Friable asbestos-containing materials (ACM) as determined in the field by a Certified Asbestos Building Inspector (CABI) through a RACS determination;
- 2) Previously non-friable ACM(s) that have been rendered friable as determined in the field by a CABI(s) through a RACS determination;
- 3) Non-friable ACM(s) that have a high probability of releasing fibers based on the forces expected to act upon the material during soil disturbance as determined in the field by a

CABI(s) through a RACS determination;

- 4) Deteriorated non-friable ACM(s) that are in poor condition resulting in a high probability to release fibers due to weathering, historical mechanical impact, fire damage (by evidence of ACM within an ash layer) or other factors as determined in the field by a CABI(s) through a RACS determination;
- 5) The following broken, resized, or damaged ACM(s) are RACS:
 - a. Asbestos cement materials
 - b. Plaster
 - c. Brittle caulking, glazing and sealants
 - d. Powdery Concrete Masonry Unit (CMU) sealant
 - e. Powdery floor leveling compound
 - f. Drywall/wallboard and associated joint compound material
 - g. Firebrick
 - h. Other material as determined by the Department, at the request of the owner or person disturbing debris, to have a high probability to release fibers.
- 6) Soil or ash known to contain non-visible asbestos based on documented evidence.

“RACS Determination” for the purpose of Section 5.5 means a determination, conducted in the field by a Certified Asbestos Building Inspector (CABI), of the friability of Asbestos Containing Material (ACM) and the probability of non-friable ACM to release fibers based on the condition of the material and the forces that are expected to act on it during disturbance. Determinations of friability shall be based on the requirements for such determinations set forth in Air Quality Control Commission Regulation No. 8 (5 CCR 1001-10, Part B). Determinations of the probability for non-friable ACM to release fibers during disturbance shall be based on the following:

- 1) The condition of the material prior to disturbance, based on observations of weathering, the integrity of the material, historical mechanical impact, or fire damage;
- 2) The potential for the material to be broken, resized or damaged during planned disturbance;
- 3) The material shall be considered RACS if the planned disturbance includes any of the following:
 - a. Augers
 - b. Rotary style trenchers
 - c. Driving on ACM lying on the surface (vehicles or equipment)

- d. Blasting or other detonation
- e. Intentional burning
- f. Other types of direct mechanical impact which are:
 - i. In direct contact with ACM or result in observation of ACM after disturbance, and
 - ii. Causing damage to the ACM

“Regulated work area” (“RWA”) as used in Section 5.5 of these Regulations means the portion(s) of a site at which soil disturbing activities involving RACS occur.

“Remediation” or “Remediate” means a cleanup or removal to prevent or minimize the possible current or future release of hazardous substances to prevent an unacceptable threat to present or future public health, welfare or the environment.

“Remedy” or “Remedial action” means those actions consistent with a permanent remedy taken instead of, or in addition to, removal action in the event of a release or threatened release of hazardous substance into the environment, to prevent or minimize the release of hazardous substances so that they do not migrate to cause substantial danger to present or future public health and welfare or the environment. The term includes, but is not limited to, such actions at the location of the release as storage, confinement, perimeter protection using dikes, trenches or ditches, clay cover, neutralization, cleanup of released hazardous substances and associated contaminated materials, recycling or reuse, diversion, destruction, segregation of reactive wastes, dredging or excavations, repair or replacement of leaking containers, collection of leachate and runoff, on-site treatment or incineration, provision of alternative water supplies, any monitoring reasonably required to assure that such actions protect the public health and welfare and the environment, and, where appropriate, post-removal site control activities. The term includes the costs of permanent relocation of residents and businesses and community facilities (including the cost of providing “alternative land of equivalent value” to an Indian tribe pursuant to CERCLA section 126(b)) where the U.S. Environmental Protection Agency determines that relocation is more cost-effective than, and environmentally preferable to, the transportation, storage, treatment, destruction, or secure disposition off-site of such hazardous substances, or may otherwise be necessary to protect public health or welfare; the term includes off-site transport and off-site storage, treatment, destruction, or secure disposition of hazardous substances and associated contaminated materials.

“Remove” or “Removal” means the cleanup or removal of released hazardous substances from the environment; such actions as may be necessary taken in the event of the threat of release of hazardous substances into the environment; such actions as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances; the disposal of removed material; or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release. The term includes, in addition, without being limited to, security fencing and other measures to limit access, provision of alternative water supplies, temporary evacuation and housing of threatened individuals not

otherwise provided for, action taken under section 104(b) of CERCLA, post-removal site control, where appropriate, and any emergency assistance which may be provided under the Disaster Relief Act of 1974.

“Render non-infectious” means to treat infectious waste by inactivating pathogens and other biologically active material to a level that will no longer present a potential hazard of infection when managed, stored or disposed.

“Residentially generated” as used in Section 16 of these Regulations means used lead-acid batteries, or used oil generated by a person or by removal of said items from a personal vehicle not used primarily for a commercial or business purpose.

“Residual sludge” means solids, semi-solids or liquids remaining in a waste impoundment after final evaporative or other treatment or storage of the waste is completed, or which may be dredged out during the active life.

“Response activity” means remove, removal, remedy, or remedial action, including enforcement activities related thereto.

“Retailer” as used in Section 10 of these Regulations means a person who sells a small quantity of product to a consumer, as opposed to a wholesaler or supplier who typically sells large quantities of products to other businesses. Retailers of tire-derived product are persons who sell small quantities of tire-derived product to consumers.

“Retailer” as used in Section 16 of these Regulations means any corporation, limited liability company, partnership, individual, sole proprietorship, joint-stock company, joint venture, or other private legal entity that engages in the sale of new lead-acid batteries, electronic devices, or lubricating oil directly to the consumer.

“Reverse distributor” means a registrant with the US Drug Enforcement Administration (DEA) who receives controlled substances acquired from another DEA registrant for the purpose of returning unwanted, unusable, or outdated controlled substances to the manufacturer or the manufacturer's agent; or where necessary, processing such substances or arranging for processing such substances for disposal.

“Risk-Based Air Threshold” for the purpose of Section 5.5 means one of the following thresholds based on project duration and receptor population, or as approved by the Department, as determined based on the sampling, analytical, and data evaluation procedures provided in Appendix 5A:

- a. an average of 0.003 fibers per cubic centimeter (f/cc) for projects with durations of thirty (30) working days or less with child receptors;
- b. an average of 0.0003 f/cc for projects with durations between thirty (30) working days and one calendar year with child receptors;
- c. an average of 0.006 f/cc for projects with durations of thirty (30) working days or less

- with only adult receptors, including commercial workers and non-OSHA workers;
- d. an average of 0.0006 f/cc for projects with durations between thirty (30) working days and one calendar year with only adult receptors excluding commercial workers and non-OSHA workers;
- e. an average of 0.0009 f/cc for projects with durations of between thirty (30) working days and one calendar year with only commercial worker receptors;
- f. an average of 0.001 f/cc for projects with durations between 30 days and one year with only non-OSHA worker receptors;
- g. if the total duration of the project exceeds, or is anticipated to exceed, one year, the owner/operator shall contact the Department for a project specific risk-based threshold.

“Run-off” means any precipitation or surface water that has not contacted solid waste material and that drains over land from any part of a facility.

“Run-on” means any precipitation or surface water that drains over land on to any part of a facility.

“Sanitary landfill” means a discrete area of land or an excavation for which the final disposal of solid waste employs a method to obtain the most dense volume practicable of the waste and covering with earth or other suitable material. A sanitary landfill may receive household waste, community waste, municipal solid waste, commercial waste, and industrial waste.

“Saturated zone” means that part of the earth's crust in which all voids are filled with water.

“Secondary lead smelter” as used in Section 16 of these Regulations means a facility that recycles lead-bearing scrap materials into elemental lead or lead alloys by smelting.

“Seismic impact zone” means an area with a ten percent or greater probability that the maximum horizontal acceleration in lithified earth material, expressed as a percentage of the earth's gravitational pull will exceed 0.10G in 250 years.

“Self-certification checklist” means a checklist of regulatory requirements applicable to entities affected by one or more Sections of these Regulations.

“Sharps” means any discarded article that may purposely or accidentally puncture or cut the skin or mucosa. Includes, but is not limited to, used needles; scalpel blades; syringes (with attached needle); pen needles; lancets; pasteur pipettes; broken blood vials; needles with attached tubing; suture needles; razor blades; tattoo pens and toothpicks; broken culture tubes and culture dishes, regardless of presence of infectious substances; broken and unbroken glassware that were in contact with infectious substances (e.g., used slides and cover slips); disposable trocars; and discarded unused or expired hypodermic needles, suture needles, syringes, and scalpel blades.

“Sharps container” means a container that is closable, puncture resistant, leakproof on the sides and bottom, and labeled or color coded in accordance with the Occupational Safety and

Health Administration (OSHA) requirements.

“Shredded circuit boards” means shredded electronic circuit boards that:

- (a) Are stored in containers that are sufficient to prevent any release to the environment prior to recovery; and
- (b) Do not contain mercury switches, mercury relays, nickel-cadmium batteries, or lithium batteries.

“Significant” means, in the context of differentiating between liquid or semisolid waste streams, a difference of one order of magnitude in the concentration of any constituent.

“Site” or “solid waste disposal site” means the location for a facility chosen based upon geologic, hydrogeologic and operational considerations. For the purpose of Section 5.5 of this regulation, “site” means the area or areas where soil- disturbing activities are occurring or will occur.

“Site boundary” means the outermost perimeter of a solid waste disposal site and facility, as designated pursuant to the Act.

“Sludge” means any solid or semi-solid waste generated by a municipal, commercial, or industrial wastewater treatment plant, water supply treatment plant, or air pollution control facility.

“Soil-disturbing activities” means digging, excavating, staging, loading, stockpiling, backfilling, compacting, grading, tilling, drilling, intrusive sampling, and equipment or vehicle movement or any other mechanical activity, that when used, disturbs the surface and/or subsurface soil. For the purposes of Section 5.5 disturbance or removal of debris and/or RACS is considered a soil disturbing activity. For the purposes of Section 5.5 hand disturbance or removal of RACS is subject to this regulation, but is not considered to be a mechanical disturbance.

“Solid waste” means any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, air pollution control facility, or other discarded material; including solid, liquid, semisolid, or contained gaseous material resulting from industrial operations, commercial operations or community activities. “Solid waste” does not include any solid or dissolved materials in domestic sewage, or agricultural wastes, or solid or dissolved materials in irrigation return flows, or industrial discharges which are point sources subject to permits under the provisions of the "Colorado Water Quality Control Act", Title 25, Article 8, CRS or materials handled at facilities licensed pursuant to the provisions on “Radiation Control Act” in Title 25, Article 11, CRS. “Solid waste” does not include: (a) Materials handled at facilities licensed pursuant to the provisions on radiation control in Article 11 of Title 25, C.R.S.; or (b) Excluded scrap metal that is being recycled; or (c) Shredded circuit boards that are being recycled.

“Solid waste disposal” means the storage, treatment, utilization, processing, or final disposal of solid wastes.

“Solid waste disposal site and facility” means the location and/or facility at which the deposit and final treatment of solid wastes occur.

“Solid waste incinerator ash” means the bottom ash, flyash or air pollution control residues and other residuals of the combustion process from the operation of incinerator or energy recovery facilities managing solid waste.

“Source of waste grease” means the location at which waste grease was initially generated.

“Source Separated” means solid waste segregated at the point of generation for special handling, disposal, composting or recycling.

“Stabilization” means mixing of a solid waste with Portland cement, or a combination of Portland cement and fly ash or cement kiln dust, to substantially reduce the amount of soluble, miscible or suspended contaminants leached from the waste.

“Staging” for the purposes of Section 5.5, means the accumulation of RACS in the RWA for twelve (12) hours or less.

“Standard Operating Procedure” (“SOP”) means a RACS management plan for multiple projects submitted in accordance with Section 5.5.5(B).

“Stockpiling” for the purposes of Section 5.5, means the accumulation of RACS that will exist for more than twelve (12) hours, up to and including ten (10) calendar days.

“Storage” for the purposes of Section 5.5, means the accumulation of RACS greater than ten (10) days, but not exceeding six (6) months unless a longer timeframe is approved by the Department and complies with local governing authority requirements.

“Store” as used in Section 18 of these Regulations means to possess, impound, contain, or control waste grease; except that “store” does not apply to the temporary retention of waste grease on the premises where the waste grease was initially generated.

“Structural component” means liner, leachate collection system, final cover, run-on/run-off control system, or any other component which is used in the construction and operation of the facility and are necessary for protection of human health and the environment.

“Structurally rigid container” means a container capable of maintaining its shape when unsupported.

“Surface water” means water that flows on the land surface, or is tributary to such water.

“Tank” means a stationary device, designed to contain an accumulation of material, that is

constructed primarily of non-earthen materials (e.g. wood, concrete, steel, plastic) that provide structural support.

“Tank system” means storage or processing tank(s) and associated ancillary equipment and containment system(s).

“Three year rolling average” means for an existing recycling facility an arithmetical average of the quantity (by weight or volume) of recyclable materials recycled at the facility during the previous three calendar years. This average shall be at least 75% by weight or volume (determined using a consistent measure) of the total amount of recyclable materials accumulated and currently in storage over a 3-year rolling average.

“Tire” means a rubber cushion that fits around a wheel.

“Tire-Derived Product” means matter that:

- (a) Is derived from a process that uses whole tires as a feedstock, including shredding, crumbing, and chipping;
- (b) Adheres to established engineering or other appropriate specifications or to established product end user specifications or customer conditions of acceptance.
- (c) Has a demonstrated benefit associated with the end use;
- (d) Can be used as a substitute for, or in conjunction with, a commercial product or raw material; and
- (e) Has either been sold and removed from the facility of a processor or has been used on site by the processor.

“Total expenditures” means all expenditures excluding capital outlays and debt repayment.

“Total revenues” means revenues from all taxes and fees but does not include the proceeds from borrowing or asset sales, excluding revenue from funds managed by the local government on behalf of a specific third party.

“Trace chemotherapy waste” means any empty container used to hold an antineoplastic drug (except P-listed hazardous waste), and contaminated items used with these drugs, such as gowns, wipes, or gloves.

“Trailer” means a wheeled vehicle, without motive power, that is designed to be drawn by a motor vehicle.

“Transfer station” means a facility at which refuse, awaiting transportation to a disposal site, is transferred from one type of containerized collection receptacle and placed into another or is processed for compaction.

“Transport” as used in Section 18 of these Regulations means to use a vehicle to haul, ship, carry, convey, or transfer waste grease from one place to another. “Transport” does not include moving waste generated on site into another on-site container, whether indoors or

outdoors.

“Transportation” means transport of persons or property by motor vehicle, bus, truck, railroad, light rail, mass transit, airplane, bicycle, or any other form of transport. Transportation includes pedestrian transportation.

“Trap grease” means the residual yellow grease, waste water, debris principally derived from food preparation or processing, or other waste that is intercepted by and contained in grease traps or grease interceptors.

“Trauma scene waste” means waste generated by the decontamination of accident scenes, crime scenes, suicides and other scenes of serious human injury or death. Trauma scene waste is a special category of medical waste that is comprised of other categories of medical waste, including blood and body fluids, pathological waste, pharmaceutical waste, potentially infectious waste and various types of sharps. This waste stream includes, but is not limited to, contaminated flooring, furniture, drywall, clothing, bedding, cleaning solutions, personal protective equipment (PPE), wipes and absorbents, and sharps contaminated with blood and body fluids or other potentially infectious material.

“Treatment” means performing a type of solid waste disposal, which includes but is not limited to, shredding, baling, liquid evaporation, and nonbeneficial sludge landspreading.

“Underground source of drinking water” means an aquifer or its portion:

- (a) Which supplies any public water system, or which contains a sufficient quantity of ground water to supply a public water system; and
- (b) Currently supplies drinking water for human consumption, or contains fewer than 10,000 mg/l total dissolved solids.

“Unstable area” means a location that is susceptible to natural or man-induced events or forces capable of impairing the integrity of some or all of the landfill structural components which are necessary for the prevention of releases from a landfill. “Unstable areas” can include poor foundation conditions, areas susceptible to mass movements, and karst terrains.

“Uppermost aquifer” means the aquifer nearest the ground surface as well as other aquifers which are hydraulically connected with this aquifer within the facility boundary or adjacent to the facility boundary.

“Used lead-acid battery” as used in Section 16 of these Regulations means any lead-acid battery that is no longer functional or no longer used for its primary purpose.

“Used oil” as used in Section 16 of these Regulations means any residentially generated motor oil, refined from crude oil or a synthetic oil, that has been used and as a result of that use is contaminated by physical or chemical impurities.

“Used tire” means a tire that was previously used as a tire and is graded and classified for

reuse as a tire based on specifications and criteria maintained pursuant to section 30-20-1410(1)(a), C.R.S.

“Vermicomposting” means an activity that produces earthworm castings through earthworm activity associated with consumption of organic materials.

“Visible” means capable of being seen with the unaided eye.

“Visible emissions” means any airborne or liquid emissions, coming from, or having come into contact with RACS, which are visually detectable without the aid of instruments. Proper disposal of appropriately filtered decontamination water does not constitute a visible emission.

“Visual Inspection” for the purposes of Section 5.5 means observation with sufficient proximity to identify discrete visible materials, while maintaining the safety of the inspector.

“Waiver” for the purposes of these Regulations shall mean a formalized process whereby an applicant may request to be excused from specific portions of these Regulations. In general a defensible technical argument must be presented and verified before a waiver may be granted.

“Washout” means the carrying away of solid waste by waters of the base flood.

“Waste electronic device” means a residentially generated device managed or deemed as solid waste, originally marketed by a manufacturer that is a computer, printer, facsimile machine, digital video disc player, video cassette recorder, peripheral, radio, stereo, video game console or a video display device or computer monitor including a laptop, television, computer monitor, notebook, ultrabook, netbook, tablet, or electronic book that contains a cathode ray tube or a flat panel screen with a screen size greater than four inches measured diagonally; but does not include any type of telephone.

“Waste grease” means trap grease in a quantity in excess of 25 gallons.

“Waste grease facility” as used in Section 18 of these Regulations means any real property location used for the collection, transportation, storage, processing, or disposal of waste grease, including, without limitation, a processing plant, transfer station, or trans-shipment location.

“Facility” does not include a domestic wastewater treatment works as defined in section 25-8-103, C.R.S., that processes waste grease as part of its operations that are regulated by the Department pursuant to Article 8 of Title 25, C.R.S. Facility does not include the real property of a personal user of waste grease.

“Waste grease generator” means a person who initially generates waste grease.

“Waste grease transporter” means a person who transports waste grease.

“Waste hauler” means any individual or any employee or agent of a partnership, private, county, or municipal corporation, firm, board of a metropolitan district, or other association of

persons that haul waste under contract, agreement, or as otherwise provided by law, to solid wastes disposal sites and facilities.

“Waste impoundment or impoundment” means a facility or part of a facility that is a natural topographic depression, excavation, pit, pond, lagoon, trench, or diked area. An impoundment, which may be lined with earthen material or synthetic material, is designed for storage, treatment or final disposal of solid waste. Examples of impoundments are holding, storage, settling, and aeration pits, ponds, and lagoons.

“Waste management unit boundary” means a vertical surface located at the hydraulically downgradient limit of the area to be filled. This vertical surface extends down into the uppermost aquifer.

“Waste pile or pile” means any noncontainerized accumulation of solid, non-flowing waste that is used for treatment or storage or processing.

“Waste stream” means a relatively uniform solid waste, produced by the same or a similar process or generator over time. Different waste streams are distinguished by significantly larger or smaller concentrations of one or more constituents as determined by standard test methods or inspection.

“Waste Tire” means a tire that is modified from its original specifications but not processed into a tire-derived product, is no longer being used for its initial intended purpose as a tire, and is not a used tire.

“Waste Tire Bale” means waste tires that are mechanically compressed and bound into block form and are secured using stainless steel or heavy gauge baling wire.

“Waste Tire Cleanup Program” means the program created by part 14 of article 20 of title 30, C.R.S.

“Waste Tire Collection Facility” means a facility at which waste tires are stored awaiting pickup by a registered waste tire hauler for transportation to a registered waste tire processor or registered waste tire monofill.

“Waste Tire Generator” means a person who generates motor vehicle or trailer waste tires. The term includes new tire retailers, used tire retailers, automobile dealers, automobile dismantlers, public and private vehicle maintenance shops, garages, service stations, car care centers, automotive fleet centers, local government fleet operators, and rental fleet operators.

“Waste Tire Hauler” means a person who transports ten or more waste tires in any one load.

“Waste Tire Monofill” means part or all of a solid waste disposal site and facility that has been issued a certificate of designation and at which only waste tires are accepted.

“Waste Tire Processor” means a person who processes a waste tire into a tire-derived product.

“Water pollution” means the manmade or man-induced alteration of the background physical, chemical, biological or radiological integrity of ground water or surface water.

“Water treatment plant sludge disposal” means the final disposal of the accumulated solids from the processing of raw water in a treatment plant of a municipality or industry.

“Wetlands” means 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, bogs, and similar areas.

“Wholesaler” as used in Section 16 of these Regulations means any corporation, limited liability company, partnership, individual, sole proprietorship, joint-stock company, joint venture, or other private legal entity that sells new lead-acid batteries, electronic devices, or lubricating oil for resale.

“Within-Vessel Composting” means a process in which compostable material is enclosed in a drum, silo, bin, tunnel, reactor, bag, or other container for the purpose of producing compost.

“Working day” means Monday through Friday and including holidays that fall on any of the days Monday through Friday.

“Working face” means that portion of a facility for solid wastes disposal where solid wastes are actively unloaded, placed, compacted and covered, at any time of operation.

“Yard Waste” means waste generated from yard maintenance, including garden waste, grass clippings, leaves and branches.

“Yards per day” means the cubic yardage of material a facility receives at the gate, for each 24 hour period.

“Yellow grease” means used cooking oil, spent shortenings, or other inedible kitchen grease or waste vegetable oil produced by restaurant and food facilities.

“100-Year flood” means a flood that has a 1-percent or greater chance of recurring in any given year or a flood of a magnitude equalled or exceeded once in 100 years, also called (base flood).

1.3 SCOPE AND EFFECTIVE DATE

1.3.1 These Regulations are based on the authorities defined and established in the Solid Waste Act, 30-20-100.5, et seq. C.R.S. Under that statute, the siting, permitting and regulation of solid waste disposal sites and facilities is an area of dual jurisdiction; that is, both the Department and local governing bodies having jurisdiction have assigned roles and responsibilities. Due to the dual nature of this process, effective coordination and communication are important to both governmental agencies involved in decisions, approvals and enforcement. The department recognizes that a cooperative relationship must be established with the governing bodies having jurisdiction or with the agency or agencies identified by such bodies as contacts for their jurisdiction. However, these Regulations cannot and do not assign to any agency authorities not granted them in statute; nor can these Regulations negate or change any authority granted to a local agency under any other statute, regulation or ordinance.

1.3.2 The effective date of these Regulations shall be October 9, 1993, with these exceptions.

(A) The financial assurance requirements contained in Section 1.8 of these Regulations shall be effective on the date specified in 30-20-104.5(4) C.R.S.

(B) The location, design, operation, closure and post-closure requirements, contained in Sections 3.1, 3.2, 3.3, 3.5 and 3.6 respectively:

(1) Shall be effective April 9, 1994, for existing municipal solid waste landfills that have accepted and continue to accept 100 tons of solid waste per day or less; and,

(2) Shall be effective October 9, 1995, for existing municipal solid waste landfills that, on or before April 9, 1994, submit an application for a waiver under Section 1.5.3.

(C) Provided no solid waste is accepted on or after April 9, 1994, the final cover requirements contained in Section 3.5 shall be effective October 9, 1994, for existing municipal solid waste landfills that have accepted and continue to accept 100 tons of solid waste per day or less.

(D)) Provided no solid waste is accepted on or after October 9, 1995, the final cover requirements contained in Section 3.5 shall be effective October 9, 1996, for existing municipal solid waste landfills that, on or before April 9, 1994, submit an application for a waiver under Section 1.5.3.

(E) Unless a further extension is granted by the Department, the ground water monitoring and corrective action requirements contained in Section 2.2.:

(1) Shall be effective October 9, 1994, for existing units or lateral expansions of existing units at municipal solid waste landfills that have accepted and continue to accept 100 tons of solid waste per day or less; and,

(2) Shall be October 9, 1995 for new units or lateral expansions or existing units at municipal solid waste landfills that, on or before April 9, 1994, submit an application for a waiver under Section 1.5.3.

All extensions of the ground water and corrective action requirements, beyond the dates listed in (1) and (2) above, shall be based upon the criteria specified in 40 CFR 258.50 and shall in no way extend beyond October 9, 1996, or otherwise violate the requirements of Subtitle D of RCRA.

(F)) In the event an application submitted under subsections (B) (2), (D) or (E) (2) is denied by the Department that municipal solid waste landfill shall comply with all applicable requirements within six (6) months of said denial.

- 1.3.3 No person shall operate a facility for solid waste disposal, where processing, treatment, or final disposal is performed, at any site without a certificate of designation obtained from the governing body having jurisdiction except as specified in 30-20-102 C.R.S. as amended.
- 1.3.4 Sites for new solid waste disposal sites and facilities shall comply with these Regulations, unless compliance with specific standards is waived by the Department in accordance with Section 1.5 of these Regulations.
- 1.3.5 The construction, operation and closure of all new facilities for solid waste disposal shall comply with designs, specifications and procedures outlined in the certificate of designation application, or in amendments to such applications approved after Department review, and with all applicable local requirements, and with the standards of these Regulations.
- 1.3.6 The construction, operation and closure of all approved facilities for solid

waste disposal that were granted a certificate of designation before there were requirements for an engineering design and operations report or that are in operation on the effective date of these Regulations, shall comply as a minimum with standards in Section 2 of these Regulations.

- 1.3.7 Solid waste disposal sites and facilities that are exempted from certificate of designation requirements under provisions of Section 1.4 of these Regulations shall comply with the applicable standards of these Regulations, unless permitted or operated in compliance with Regulations pursuant to the "Colorado Mined Land Reclamation Act", Title 34, Article 32, Section 101, et seq., CRS, as amended; or the "Hazardous Waste Act", Title 25, Article 15, Parts 1, 2, and 3, CRS, as amended.
- 1.3.8 Technical guidelines, including specific technical factors, may be developed and issued by the Department to assist applicants, local governments, and the public.
- 1.3.9 (A) All solid waste disposal sites and facilities are reviewed and approved for a specific owner/operator; a specific waste stream; a specific design; a specific operation plan. Significant changes to the above are required to be approved by the Department. Such approval or denial shall become a part of the operating record. The information describing changes relating to the above items shall be submitted and described in appropriate detail and in a clear and concise format. This is required in order to maintain current information and status on sites and facilities for monitoring and enforcement purposes.

(B) Sites and facilities subject to 40 CFR Part 258 shall submit a compliance information applicable to their site for the compliance plan per Section 3.0.

(C)) Nothing in this section shall preclude any review action by the local governing authority under 30-20-100.5 et seq. or appropriate local ordinance or rule.
- 1.3.10 Statements of the basis and purpose for these Regulations have been prepared and adopted by the board of health, and hereby incorporated into these Regulations by reference, pursuant to the "Colorado Administrative Procedures Act", Title 24, Article 4, Section 103, C.R.S. 1973, as amended. A statement of basis and purpose for each change in the Regulations is drafted to give the reasons for the regulatory change enacted. Copies are on file with the Department.

1.3.11 These Regulations shall apply to all solid waste disposal sites and facilities as provided for in CRS 30-20-100.5 and herein.

(A) The minimum standards (Section Two) shall apply to all sites and facilities.

(B) Section 3.0 shall apply to all solid waste disposal landfills and facilities.

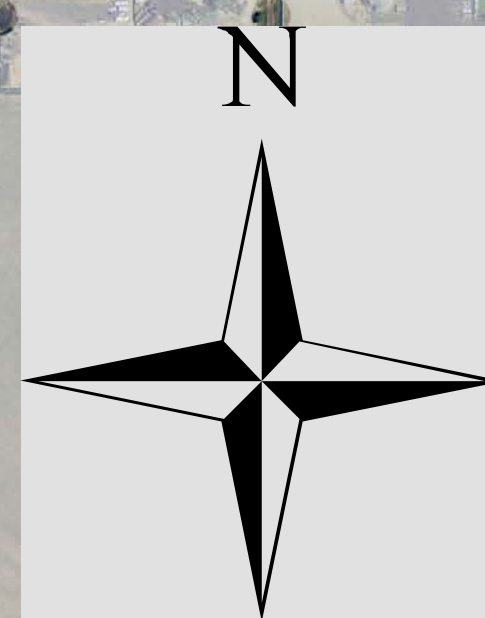
(C) Sections 4 through Section 13 are specific to specific waste streams and facilities.

Section Two is meant to be used in conjunction with all other sections. The Department recognizes that all the criteria may not be applicable to all sites, facilities or waste streams.

APPENDIX B

Figure A-1 – Asbestos Containing Materials (ASM) Status, BAFB, CO. Date: Mar 16

This Page Intentionally Left Blank



Buckley Air Force Base
RACS Figure A-1
2016



460 Civil Engineer Squadron, GeoBase Office
660 S Ames St (Stop 86), Building 1005
Buckley AFB, Colorado 80017
P: 720-847-9309 or 720-847-7670 Web: <https://crwu-geo.civm>

Legend

	Former Facility Area		Buildings		Lake Williams
	Capped Sites with Known RACS		Pavilion		Playgrounds
	Former Facility Area		Slab		Athletic Field
	Fuel Tanks		Pavement		Installation Boundary
	Fences		Streams		

1 inch = 450 feet

For Official Use Only
Project: Colorado State House Central
Sheet: 0001 of 0001
Date: 10/1/2016

This Page Intentionally Left Blank

APPENDIX C

List of Suspect Asbestos Containing Building Materials

This Page Intentionally Left Blank

LIST OF SUSPECT ASBESTOS CONTAINING BUILDING MATERIALS

Acoustical Plaster

Adhesives

Asphalt Floor Tile

Base Flashing

Blown-in Insulation

Boiler Insulation

Breaching Insulation

Caulking/Putties

Ceiling tiles and Lay-in Panels

Cement pipes, siding and wallboard (Including asbestos cement water lines)

Chalkboards

Construction Mastics (floor tile, carpet, ceiling tile, etc.)

Cooling Towers

Decorative Plaster

Ductwork Flexible fabric Connections

Electrical Cloth

Electrical Panel Partitions

Electrical Wiring Insulation

Elevator Brake Shoes (other brake shoes; generator, crane or hoist)

Elevator Equipment Panels

Fire Blankets

Fire Curtains

Fire Doors

Fireproofing Materials

Flooring Backing

Heating and Electrical Ducts

High Temperature Gaskets

HVAC Duct insulation joint compound

Laboratory Hoods/table tops

Magnesite (Cementous type) Flooring

Packing Materials (for wall/floor penetrations)

Pipe Insulation (corrugated air-cell, block, etc.)

Roofing Felt

Roofing Shingles

Spackling Compounds

Spray Applied Insulation

Taping Compound (thermal)

Textured Paints/ Coatings

Thermal Paper Products

Vinyl floor Tile

Vinyl Sheet Flooring

Vinyl Wall Coverings

Wallboard

APPENDIX D

Notification Forms

Refer to CDPHE website for current notification forms

This Page Intentionally Left Blank

**Colorado Department of Public Health and Environment
Hazardous Materials and Waste Management Division
Asbestos Contaminated Soil Notification Form**

10 DAY NOTIFICATION OF PLANNED ASBESTOS MANAGEMENT

For notification of planned management of asbestos-contaminated soil, a completed copy of this form should be submitted to the Hazardous Materials and Waste Management Division at least 10 working days prior to any planned soil-disturbing activity. If the Division has not pre-approved standard operating procedures that will be implemented, you must also submit a **Soil Characterization and Management Plan** to the Division for approval. If the Division has pre-approved standard operating procedures that will be implemented, then you only need to submit a completed copy of this form.

The form and plan can be mailed to: Colorado Department of Public Health and Environment, HMWMD-B2 Attn: Solid Waste Unit Leader, 4300 Cherry Creek Drive South, Denver CO 80246-1530
or emailed to: comments.hmwmd@state.co.us.

Date and time reported:			
Contact person for entity performing soil-disturbing activity:		Phone:	Ext:
Organization, company or agency:			
Address:			
City:	State:	Zip:	
Name of property owner/operator or property representative:			
Owner/operator contact (if different):		Phone:	Ext:
Address:		Fax:	
City:	State:	Zip:	
Location of property: (Street address or other location description – e.g. highway mile marker)	Street Address:		
	County:	City:	Zip:
General Site Description:			
Description of planned soil-disturbing activities:			
Description of material that will be disturbed:			
Has the Division pre-approved standard procedures that will be implemented? <input type="checkbox"/> yes <input type="checkbox"/> no If “no,” submit a Soil Characterization and Management Plan for Division review and approval.			

**Colorado Department of Public Health and Environment
Hazardous Materials and Waste Management Division
Asbestos Contaminated Soil Notification Form**

24 HOUR NOTIFICATION OF UNPLANNED ASBESTOS DISCOVERY

For 24-hour notification of the unplanned discovery of asbestos-contaminated soil, a completed copy of this form should be faxed to 303-759-5355 Attn: Solid Waste Unit Leader, or emailed to comments.hmwmd@state.co.us. If the Hazardous Materials and Waste Management Division has not pre-approved standard operating procedures that will be implemented, you must then submit a **Soil Characterization and Management Plan** to the Division for approval. If the Division has pre-approved standard operating procedures that will be implemented, you only need to submit a completed copy of this form.

The Soil Characterization and Management Plan should be mailed to: Colorado Department of Public Health and Environment, HMWMD-B2 Attn: Solid Waste Unit Leader, 4300 Cherry Creek Drive South, Denver CO 80246-1530 or emailed to: comments.hmwmd@state.co.us.

Date and time reported:			
Contact person for entity performing soil-disturbing activity:		Phone:	Ext:
Organization, company or agency:			
Address:			
City:	State:	Zip:	
Name of property owner/operator or property representative:			
Owner/operator contact (if different):		Phone:	Ext:
Address:		Fax:	
City:	State:	Zip:	
Discovery date:		Discovery time (include AM or PM):	
Location of property: (Street address or other location description – e.g. highway mile marker)	Street Address:		
	County:	City:	Zip:
General Site Description:			
Activity resulting in discovery:			
Description of material encountered:			
Description of access or emissions controls implemented:			
Has the Division pre-approved standard procedures that will be implemented? <input type="checkbox"/> yes <input type="checkbox"/> no If “no,” implement interim actions and submit a Soil Characterization and Management Plan for Division review and approval.			

APPENDIX E

6 CCR 1007-2, Part 1 Sections 5 Appendix 5A

This Page Intentionally Left Blank

APPENDIX 5A

SAMPLE COLLECTION PROTOCOLS AND ANALYTICAL METHODOLOGIES

1.0 Purpose

(A) The purpose of this appendix is to establish standard sample collection requirements and analytical methods and procedures for use in identifying and quantifying asbestos fibers in air, bulk material, and environmental media such as soil or ash.

2.0 Sample Collection Requirements

(A) The following sample collection requirements shall be followed when collecting samples for the purpose of determining the applicability of Section 5.5, and when collecting samples necessary to comply with the requirements of Section 5.5. Remediation plans submitted in accordance with Section 5.5.6 shall include a site specific sampling and analysis plan that incorporates the sample collection methodologies and analytical procedures in this Appendix, or proposes alternatives, and include site specific clearance criteria.

2.1 Bulk Samples

(A) Bulk samples shall be collected, in a manner sufficient to determine whether the material is asbestos-containing material (ACM) or not ACM, from each type of suspect ACM. Bulk samples shall be collected by a State of Colorado certified Asbestos Building Inspector (CABI). In the absence of bulk sample collection, any suspect ACMs must be assumed to be ACMs.

(B) Bulk samples shall be collected by homogenous type based on color, pattern, texture, thickness, associated materials, or by other identifying characteristics. Additionally, the quantity and location of a suspect material shall be used to determine the number of bulk samples required to characterize the asbestos content of each homogeneous suspect material. For the purpose of determining that a homogeneous suspect material does not contain asbestos, a minimum of three (3) bulk samples shall be collected from the homogeneous material unless there is insufficient material to constitute three (3) samples. If one of the collected samples of a homogeneous bulk material is determined to be ACM, then the homogeneous material shall be considered ACM.

2.2 Soil Samples

(A) Samples collected to determine asbestos content in soil shall be ten (10) point aliquot composite samples collected from a maximum area of 1,250 square feet (representing 0-6 inches beyond the exposed surface) or a maximum volume of forty (40) cubic yards. Individual aliquots shall be approximately 1/10 of the entire sample volume. At each aliquot location approximately one (1) tablespoon of soil shall be collected. The total volume of the ten (10) aliquots should equal roughly a half cup. The total collected sample volume should be greater than one quarter (1/4) cup, but should not exceed one cup. Aliquot locations shall be randomly selected but shall be representative of the entire sample area or volume (to be inclusive of the interior of soil piles in addition to the surface). However, aliquots shall be co-located with any areas where friable ACM was formerly present. All samples collected to determine asbestos content shall be collected by a CABI.

(B) Sampling for clearance purposes of any exposed horizontal or vertical surface shall have the following additional requirements:

1) The aliquots of a clearance sample shall not be collected until after the RACS, and the required amount of associated material, has been removed.

2) A visual inspection shall be performed and passed (i.e., no visible ACM present) by a CABI prior to the collection of soil samples. Visual inspections shall include the following:

- a) The area to be cleared shall be designated before the visual inspection; and
- b) Former locations of friable materials shall be designated; and
- c) The surface being inspected shall be dry enough to allow identification of suspect ACM; and
- d) The visual inspection shall be conducted in adequate lighting; and
- e) The area to be cleared shall be free of visual impediments (e.g. snow cover, plastic sheeting, standing water, etc.); and
- f) At a minimum, the area to be cleared shall be inspected in at least two (1) perpendicular directions; and
- g) Single or multiple inspectors may be used to perform a visual inspection and clearance. However, a single inspector shall not visually inspect more than a five (5) foot width with each pass [i.e. for a clearance area that is 25' x 50' a single inspector would be required to make at least five (5) passes in one direction (25' length) and at least ten (10) passes in the other direction (50' length)]; and
- h) Detailed close examination of the area being cleared is required. The inspector(s) should use limited invasive inspection techniques, such as periodically sifting the surface being cleared and closely inspecting the disturbed area.

3) If sidewalls with six (6) inches or greater of vertical height are present, independent ten (10) point aliquot composite samples shall be collected from each of the sidewalls and the floor of the excavation.

2.3 Ash Samples

(A) Ash that contains, or is comingled with, suspect ACM and/or construction and demolition debris shall be considered to be RACS unless the ash is sampled, and analysis demonstrates that the ash is not RACS. Representative samples of each type of ash materials shall be sampled and analyzed in the same manner as soil (including area/volumetric limitations of sampling). Ash samples shall be collected by homogenous strata, location, content of other surrounding material, or other observations indicating heterogeneity of the ash present. All samples collected to determine asbestos content shall be collected by a CABI. In the absence of suspect ACM or construction and demolition debris, and in the absence of documented evidence of non-visible asbestos, ash material may be treated as non-RACS.

2.4 Cross Contamination Prevention

(A) All sample collection equipment shall be decontaminated in a manner sufficient to prevent cross contamination between individual samples or individual composite samples. Decontamination is not required between the collection of aliquots comprising a single composite sample.

2.5 Air Samples for Standard RACS Management

(A) Air samples shall be collected by drawing air through 0.8-micron (μm), 25-millimeter (mm), mixed cellulose ester (MCE) filters, using an open-faced cowl extension oriented face down at an angle of 45° . Sample flow rate shall be between 0.5-10 liters per minute depending on the anticipated duration of sampling and the specified detection sensitivity. The air sampling equipment shall be run until the minimum volume required is collected for each sample. However, if the minimum air volume required by the method, and/or to reach the required analytical sensitivity, being utilized cannot be met, the State of Colorado trained and certified Air Monitoring Specialist (AMS) shall request that the laboratory prepare the sample using an indirect preparation method, for TEM presence/absence analysis. Air samples shall be collected at a height that is representative of the disturbance activity taking place. However, air samples shall be located at a height between three (3) feet above the ground surface but not to exceed twenty (20) feet above the ground surface. Air samples shall be collected by an AMS.

2.6 Air Samples for Risk-Based Air Threshold Monitoring

(A) Air samples shall be collected by an AMS. Air monitoring shall be conducted during each partial or full day of soil management activities using fixed and mobile monitors as follows:

- 1) A minimum of four (4) samples shall be collected for each regulated work area (RWA).
- 2) For the purpose of determining the number of samples necessary, each RWA shall be divided into four (4) equal quadrants. A minimum of one (1) sample shall be collected for each quadrant with an adjacent receptor zone.
- 3) If an RWA is greater than one (1) acre, one (1) additional sample for each quadrant with an adjacent receptor zone shall be collected and analyzed for each additional one quarter (1/4) acre in RWA surface area.
- 4) Samples shall be located along the RWA perimeter, between the RWA and each adjacent receptor zone. Samples shall be placed between the RWA and any fixed adjacent receptor(s). In the absence of fixed adjacent receptors, sample placement shall be at the AMS's discretion.
- 5) The sample volume shall be the minimum necessary to meet analytical sensitivity.
- 6) Samples shall be collected by drawing air through 0.8-micron (μm), 0.25-millimeter (mm), mixed cellulose ester (MCE) filters, using an open-faced cowl extension oriented face down at an angle of 45°.

3.0 Analytical Requirements

(A) The following analytical methods shall be used to evaluate the presence of asbestos and/or to determine asbestos content when analyzing samples for the purpose of determining the applicability of Section 5.5, and when analyzing samples collected in accordance with Section 5.5:

3.1 Bulk Samples

(A) Samples of suspect ACM shall be analyzed by polarized light microscopy (PLM), according to United States Environmental Protection Agency (USEPA) Method EPA/600/R-93/116 or equivalent method, to determine if any asbestos fibers are present. If the asbestos content of a sample is estimated to be 1% asbestos or less, but greater than 0%, by a method other than point counting (such as visual estimation), the determination shall be repeated using the point counting technique with PLM. Alternatively, the material may be assumed to be ACM. Analysis shall be conducted by a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory.

3.2 Soil Samples and Ash Samples

(A) Prior to preparation of a soil or ash sample, bulk materials shall be separated from the soil or ash sample for independent analysis. Any bulk materials identified in a soil or ash sample that contain any amount of asbestos shall be reported as independent layers of the whole sample. The samples shall be adequately prepared (crushed and dried) to facilitate stereomicroscopic analysis by the laboratory. The goal of the preparation process should be to produce dried conglomerates of approximately one eighth inch (1/8") to one quarter inch (1/4") size. Rock and/or stone material does not need to be crushed (this process is not intended to be homogenization). Soil and ash samples shall be analyzed by PLM according to USEPA Method EPA/600/R-93/116 to determine if any asbestos fibers are present. Analysis shall be conducted by a National Voluntary Laboratory Accreditation Program (NVLAP) accredited laboratory. During the stereomicroscopic analysis (10X – 50X) of the soil/ash sample the analyst shall sift through the sample at a rate of approximately one (1) tablespoon per minute. At the end of the stereomicroscopic analysis the sample shall be agitated or shaken as a final check for asbestos prior to the preparation of PLM grab mounts. At no time during the stereomicroscopic analysis shall a sub sample be collected. The entire sample shall be analyzed and the results reported. If no asbestos was identified by PLM after the initial stereomicroscopic examination, then three (3) random grab mount preparations shall be analyzed by PLM to determine if the sample is none detected for asbestos content. If any asbestos is found by the laboratory it shall be reported even in the absence of a second detection (i.e. there does not need to be a second detection to qualify a trace level of asbestos in the sample). Quantification of asbestos content shall be based on the entire sample volume, and be reported as such.

3.3 Air Samples for Standard RACS Management

(A) Air samples submitted for Phase Contrast Microscopy (PCM) shall be analyzed according to NIOSH Method 7400 by a laboratory showing successful participation in the American Industrial Hygiene Association (AIHA) Proficiency Analytical Testing (PAT) Program or individual(s) certified through the AIHA Asbestos Analysts Registry (AAR) Program.

(B) Air samples submitted for Transmission Electron Microscopy (TEM), for which quantification of asbestos is desired, shall be prepared and analyzed according to the standard Asbestos Hazard Emergency Response Act (AHERA) method (AHERA; 40 CFR Part 763, Subpart E, Appendix A). All TEM analysis shall be performed by a NVLAP accredited laboratory. If a presence/absence analysis is desired, the analysis shall be performed using the AHERA method modified in the following manner:

- 1) A minimum of two (2) preparations shall be prepared and utilized for each sample.
- 2) Analysis shall be conducted on a minimum of four (4) grid openings or until three (3) or more structures are identified, whichever comes first.
- 3) Any structure (adhering to the AHERA counting rules) identified during analysis shall be reported.

- a) Identification of less than three (3) structures shall be reported as present.
- b) Identification of three (3) or greater structures shall be reported as detected.

(C) Any air sample analysis that results in a “cannot be read (CBR)” determination from the analyst, or a “not analyzed (NA) or rejected” due to loose debris or uneven loading, shall be evaluated by the AMS to determine if a cause of the CBR or NA can be ascertained. If it is determined that the CBR is a result of overloading from airborne emissions, then the AMS shall request that the laboratory prepare the sample, using an indirect preparation method, for TEM presence/absence analysis.

3.4 Risk-Based Air Threshold Samples

(A) Air samples collected for TEM analysis shall be submitted to a NVLAP accredited laboratory. Samples shall be analyzed by TEM according to ISO Method 10312 with the following modifications for PCM equivalent (PCMe) structures:

- 1) An aspect ratio of 3:1 shall be used when counting structures greater than 5 µm in length, rather than the 5:1 ratio specified in the method.
- 2) A width range of 0.25 to 3 µm will be used when counting PCMe structures, rather than the 0.2 to 3 µm specified in the method.
- 3) A minimum of ten grid openings will be counted, rather than the minimum of four (4) grid openings specified in the method.
- 4) Calculations shall be made based on total fibers rather than primary fibers.

(B) The maximum number of grid openings (GOs) to be counted to achieve the specified analytical sensitivity shall be estimated as follows:

Number of GOs = $EFA \div (AGO \times V \times S \times CF)$ where:

EFA = effective filter area (385 for a 25-mm filter)

AGO = area of a grid opening (approximately 0.01 mm²; actual value to be provided by the analytical laboratory)

V = volume of air sampled (in liters [L])

S = analytical sensitivity (structures per cubic centimeter [s/cc]) CF = conversion factor (1000 cc/L)

(C) Any air sample analysis that results in a “cannot be read (CBR)” determination from the analyst, or a “not analyzed (NA) or rejected” due to loose debris or uneven loading, shall be prepared by the laboratory, using an indirect preparation method, for TEM presence/absence analysis.

3.5 Data Evaluation for Risk-Based Air Threshold Samples

(A) General requirements:

- 1) Samples collected for comparison to risk-based air thresholds shall be evaluated based on the average (mean) concentration over the exposure duration.
- 2) All valid data shall be used to calculate daily and ten (10) day rolling averages.
- 3) For all projects a minimum of three (3) samples per day must have quantifiable data (not CBR or rejected). If less than three (3) quantifiable analytical results are available then the daily average is invalid.

(B) Project days 1-9:

- 1) The results of the daily samples must be averaged to calculate a daily average for use in comparing to the risk based air threshold for days 1- 9 of monitoring.
- 2) A ten (10) day average shall be calculated for days 1-9. The ten (10) day average shall be comprised of at least eight (8) valid daily average results. However, all valid data shall be used to calculate the ten (10) day average.
- 3) If the ten (10) day average exceeds the risk-based air threshold, engineering controls shall be adjusted to reduce the daily average.
- 4) The Department shall be notified within 24 hours if the calculations in paragraphs 1 and 2 above cannot be completed due to invalid data.

(C) Project days 10 and greater:

- 1) Starting on day 10, a ten (10) day rolling average shall be calculated and compared to the risk-based threshold.
- 2) If average concentration trends indicate the risk-based air threshold will be exceeded before project completion, engineering controls shall be adjusted to reduce the daily asbestos emissions.
- 3) If subsequent evaluation of average concentration trends indicates that the risk-based air threshold will still be exceeded before project completion, additional adjustments to engineering controls shall be made.
- 4) If changes in engineering controls are not effective in reducing airborne concentration trends such that the risk-based air thresholds can be met, consultation with the Department is required.
- 5) The Department shall be notified within five (5) working days if the averaged airborne asbestos concentration for the entire project exceeds the risk-based air threshold.

4.1 Documentation

(A) All of the following sampling and analytical documentation shall be maintained during a project and available for Department review upon request. This documentation need not be submitted to CDPHE unless requested or as required in a project specific plan.

1) Documentation of bulk, soil, and ash samples shall include:

- a. A description of the material being sampled including friability.
 - i. For samples collected for characterization purposes also include an estimate of the quantity of visible suspected RACS present.
 - ii. For samples of ash, also include a brief description of the ash layer, and any associated identifiable debris.
- b. Name of person collecting the sample(s).
- c. Date and time of sample collection.
- d. Location of sample collection (a map, drawing, or diagram showing sample locations in relation to the work area and surrounding area).
- e. The boundary/limits that are represented by the collected sample.
- f. Chain of custody documentation.
- g. Laboratory analysis reports.
- h. Log of characterized homogeneous bulk materials including material descriptions, photographic documentation, and asbestos content.

2) Documentation of air samples shall include:

- a. Name of person collecting the sample(s).
- b. Date and time(s) of sample collection.
- c. Locations of air sample collection.
- d. Any relocation of air samples.
- e. A map, drawing, or diagram showing air sample locations (initial and relocations) in relation to the work area and the surrounding area.
- f. Chain of custody documentation.
- g. Laboratory analysis reports.
- h. Explanation of any air sample malfunctions and any voided air samples.
- i. Risk based air threshold concentration calculations.
- j. Air sample data (flow rates, time of sampling, volumes, calibration method, etc.).
- k. Wind speed measurements.
- l. Prevailing wind directions.
- m. Wind shut down events.
- n. Observations of visible emissions and responses.

5.1 Deviations from Sampling and Analysis Procedures

(A) Deviation from this sampling and analysis appendix shall only be allowed upon consultation with, review by, and approval from, the Department.

This Page Intentionally Left Blank

APPENDIX F

**460 CES SQUADRON DUTY OFFICER (SDO) AND ON-CALL CRAFTSMAN POLICY
LETTER**

This Page Intentionally Left Blank



DEPARTMENT OF THE AIR FORCE
460TH SPACE WING (AFSPC)

6 Oct 15
P-00a

MEMORANDUM FOR 460 CES/CEO

FROM: 460 CES/CC

SUBJECT: Squadron Duty Officer (SDO) and On-Call Craftsman Policy Letter

1. This policy letter outlines the standard operating procedures for non-duty hours for the 460 CES Squadron Duty Officer (SDO), Shop Foremen/NCOIC, and On-Call Personnel. This policy is to be used with other procedures and policies to ensure timely and comprehensive response to emergency situations after normal duty hours, weekends, holidays, and down days. All personnel will ensure timely response to enhance customer relationships, reduce damage, and ensure adequate support to Buckley AFB missions.

2. GENERAL SERVICE CALL PROCESS: After normal duty hours, 460 CES maintains the capability to respond quickly to customer and mission emergencies through its service call process. After normal duty hours, the customer will contact the Emergency Control Center (ECC). The ECC will contact the SDO to evaluate and execute the appropriate response. The 460 CES SDO maintains a roster of On-Call Personnel who can respond to emergencies across the range of civil engineer disciplines.

a. After normal duty hours is defined as:

(1) Monday – Thursday, 1600 – 0715.

(2) Friday 1600 – Monday 0715.

(3) Holidays and Down Days – 24 hours on call.

(4) Special Events as deemed by the Commander.

3. FUNCTION OF THE SDO PROGRAM MANAGER: The SDO Program Manager will be the Operations Superintendent. The SDO Program Manager will provide a minimum 90-day SDO schedule. The schedule will be posted with Customer Service 30 days prior to expiration of the previous schedule period.

4. FUNCTION OF THE SDO: The SDO will represent the Squadron Commander and Operations Flight Commander on all official civil engineering **EMERGENCY** and **MISSION ESSENTIAL** concerns after normal duty hours. Active duty personnel in the grades of Technical Sergeant through Captain (with the exception of the SEM) holding a CE specialty and having a minimum of 2 months' time on station will be assigned SDO responsibilities. Air Reserve Component (ARC) personnel otherwise eligible will be approved by the Operations Flight Commander or designated representative as an addition to the SDO roster.

a. DUTIES OF THE SDO: The on-coming and out-going SDOs will meet in the Operations Flight conference room with all On-Call Personnel at 0830 each Monday to brief the current events, On-Call responsibilities and to ensure all contact information is correct. **It is the responsibility of the SDO to perform a functional communications check with each On-Call person to ensure the primary contact phone numbers are adequate and reliable.** The on-coming SDO is responsible for ensuring all On-Call Personnel and the out-going SDO attends this meeting. If scheduled events prevent the Monday SDO/On-Call duty meeting, the SDO will coordinate an alternate changeover.

b. The out-going SDO will review the SDO events log with the in-coming SDO for any significant events that occurred during the duty. The out-going SDO will transfer the log and cell phone to the incoming SDO. Accountability for these items will be accomplished by **signing the SDO events log and transfer sheet.**

c. As required, the Operations Flight Chief or designated representative will brief the SDO at the close of any duty period on any significant situations such as the following:

(1) Any open emergency or mission essential work or unresolved utility outages.

(2) Current or forecasted weather such as snow, extreme cold, or wind that could damage facilities or infrastructure or have an impact on mission accomplishment.

(3) 460 CES personnel working overtime or other than normal hours.

d. The SDO will remain in the local area and ensure the ECC is informed of his/her status and contact procedures at all times. **In the event** that the **SDO cannot fulfill assigned duties** due to illness, injury, etc., he/she must **contact** the 460 CES **SDO Program Manager** for any SDO changes. Any SDO schedule changes due to leaves, TDYs or other planned events will be coordinated by the effected SDO and approved by the SDO Program Manager.

e. In the event of an emergency call during off duty hours, the SDO will contact the customer and confirm the nature of the call and dispatch the appropriate On-Call Craftsman. The SDO will contact the appropriate section superintendent when On-Call Craftsman cannot resolve the situation. The SDO will contact Operations Flight leadership with any issue may require squadron commander or higher level involvement.

f. The SDO will document all calls in the SDO events log. **All information regarding the outcome of the situation must be followed up with the ECC and/or 460 CES Customer Service first thing in the morning on the next business day.**

g. The SDO will follow On-Call calls from **“cradle to the grave”** and ensure work orders are cut the next duty day at Customer Service.

h. The SDO is also required to directly coordinate activities for any of the following reasons:

(1) A situation cannot be resolved by ECC, Shop Foremen/NCOIC, or On-Call Personnel.

(2) Any major utility outage that has affected two or more facilities.

(3) A major accident that requires the presence of an On-Scene Commander.

(4) Any major system failure such as fuel spills, loss of vital mission support facilities, etc.

(5) A situation that will predictably garner the attention of the Squadron, Group, or Wing Commander. This includes problems at high occupancy or mission facilities such as dormitories and communications mission facilities.

(6) Emergency/off-duty hour situations requiring a Work Clearance Request (AF Form 103), the SDO will contact someone from the 460 CES Customer Service section to have the request processed. The 460 CES Customer Service must coordinate with all agencies/entities listed on the AF Form 103 prior to work approval. Once all coordination has been completed the request can be approved. The 460 CES Customer Service/SDO must brief the requester on any noted precautions listed on the form and ensure the requester dates and initials the back of the form prior to issuing the AF Form 103 to the requester. The SDO shall follow-up with the requester to ensure any applicable precautions have/are being carried out as instructed.

i. SDO is required to brief the Ops Flight Commander daily on emergency work and at changeover for any non-emergency items.

j. SDO will notify the Ops Flight Commander in the event "on-site" arrival will exceed 1 hour.

k. The SDO will ensure the 460 CES compound is secure at the end of each duty day. On normal duty days (not before 1600 hours and not later than 1730 hours) the SDO will check the compound front gates (adjacent to 460 CES/CEI), the personnel gate (adjacent to 460 CES/CEX), and the back gate (adjacent to Material Acquisition) to ensure each is closed and secure. Notify appropriate On-Call personnel if the gate is not able to be secured. Personnel entering and exiting the gates after being closed and locked are responsible for securing the gates behind them.

5. BAFB EMERGENCY CONTROL CENTER (ECC): The 460 CES Customer Service Desk will transfer phones to the ECC during non-duty hours, special events, goal days, and down days. The ECC will then serve as the proxy customer service for all emergency work requests. The ECC Operator will respond to the incoming calls and pass the information on to the SDO. IAW AFPAM 32-1004, vol 3 emergencies are defined as follows: *"Emergency work is work required to correct an emergency condition that is detrimental to the mission or reduces operational effectiveness. An emergency condition is one that, if not corrected immediately, could result in a major compromise of the mission. An emergency will always include, but is not limited to, failure of any utility, fire protection, environmental control, or security alarm system."* Additionally, pre-existing shop policies/instructions can be used to make this decision.

a. The ECC must gather the following information from the in-coming call:

(1) Name of Requestor.

(2) Phone Number.

(3) Reason and Nature of Call.

(4) Exact location of the incident: address/facility number, etc.

b. The ECC will keep a log and track all incoming calls and work requests in the after duty event log. All follow-on requirements for work will be forwarded to the appropriate Customer Service points to generate urgent or routine work orders. The ECC will notify all involved of the ultimate disposition of those service calls involving the Squadron Duty Officer, Ops Flight Commander (or Deputy), and/or Squadron Commander.

c. The ECC also has sets of keys for any facilities on base that needs to be accessed during off-duty hours. **If a craftsman needs access to these facilities, they must contact the ECC at 847-9928 in order to be escorted in that particular facility.**

d. During major emergencies as defined by 460 CES/CEF Flight Chief, UCC activation during Major Accident Response Exercise (MARE) or real world, the work order line **cannot** be transferred to the Fire Department. The dispatcher will be busy with the current emergency or exercise.

6. ON-CALL PERSONNEL RESPONSIBILITIES: On-Call Personnel are appointed to remain ready to respond after normal duty hours as required for emergencies. The On-Call period for all appointed personnel begins at COB on Mondays and continues until relieved at COB the following Monday or until a complete changeover has been accomplished.

a. The SDO will call the appropriate On-Call Craftsman using their best judgment for determining the appropriate craft. **If the SDO is unable to contact the On-Call Person, they will contact the shop foreman.** It will then be the responsibility of the Shop Foreman/NCOIC to solve the problem.

b. The on-coming/out-going SDOs will conduct a changeover meeting at 0830, every Monday. All in-coming and out-going On-Call Personnel will attend to ensure their phone numbers are valid and brief issues as required. If delayed reporting, down days, holidays or other events prevent the Monday SDO/On-Call duty meeting, the on-coming SDO will coordinate an alternate changeover.

c. **Any schedule changes regarding On-Call Personnel list must be coordinated with your respective shop superintendents.**

d. On-Call Personnel will adhere to the following:

(1) **No Alcohol will be consumed while on On-Call.**

(2) On-Call Personnel are responsible for staying within their commuting area to ensure they are able to respond to an emergency call via phone within 30 minutes and be able to arrive at the scene of the emergency within a reasonable amount of time.

(3) Military On-Call Craftsmen will be "on site" in uniform as soon as possible. Civilian Craftsmen will stay in constant communication of requestor if "on site" arrival will exceed 1 hour.

(4) On-Call Personnel will obey all traffic laws and drive safely, especially during inclement weather.

(5) Contact shop superintendents for problems beyond your breadth of knowledge and expertise.

(6) Provide the SDO with ETA to Site, Status, type of work accomplished, and outcome of call.

(7) Respond back to the Fire Department with the status or outcome within 30 minutes of completion.

7. **SHOP FOREMAN/NCOIC. Shop Foreman/NCOIC will establish an On-Call roster in advance and schedule activities, leave and time-off accordingly with the SDO.** Any changes to the roster must be submitted to the SDO and Operations Engineering element immediately.

a. The Shop Foreman/NCOIC will ensure all On-Call Personnel are aware of the schedule and know their responsibilities as spelled out in this plan. The Shop Foreman/NCOIC will monitor new personnel and assign personnel when qualified to be included in On-Call rotation. The Shop Foreman/NCOIC will conduct training programs to ensure all personnel meet minimum On-Call requirements as soon as possible.

8. If there are any questions on this policy, please contact the SDO Program Manager, MSgt David Lewis at 847-9272 or at david.lewis.27@us.af.mil or the Deputy Operations Director, Mr. Robert Powers at 847-9275 or at robert.powers.2@us.af.mil.



CYNTHIA R. CLEFISCH, Lt Col, USAF
Commander, 460th Civil Engineer Squadron

APPENDIX G

AF FORM 103 WORK CLEARANCE REQUEST

This Page Intentionally Left Blank

BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST						DATE PREPARED
<i>(See Instructions on Reverse)</i>						
1. Clearance is requested to proceed with work at _____						
on Work Order No. _____		332 or Contract # _____				
This area <input type="checkbox"/> Has <input type="checkbox"/> Has not been staked or clearly marked. Involving excavation or utility disturbance per attached sketch.						
2. TYPE OF FACILITY/WORK INVOLVED (mark "X" in all applicable fields)						
A. PAVEMENTS	D. FIRE DETECTION & PROTECTION SYSTEMS		G. AIRCRAFT OR VEHICULAR TRAFFIC			
B. DRAINAGE SYSTEMS	E. UTILITY	OVERHEAD	UNDERGROUND		H. SECURITY	
C. RAILROAD TRACKS	F. COMM	OVERHEAD	UNDERGROUND		I. OTHER	
3. NAME/SIGNATURE REQUESTING OFFICIAL			4. TELEPHONE NO.		5. ORGANIZATION	
6. NAME / SIGNATURE OF CONTRACT COR / INSPECTOR (is applicable)			7. TELEPHONE NO.		8. ORGANIZATION	
9. We request that the following information be given at the time the request is processed.						
A. Description of work to be accomplished.						
B. What type of digging equipment will you be using?						
C. How wide of an opening is required? (Length X Width)				D. What is the maximum depth required?		
E. Can the depth be modified?				F. Date clearance is required		
Requester will be responsible for maintaining own locates and following 460 CES guidelines						
1 0. C I V I L E N G I N E E R I N G	460 CES		REMARKS		REVIEWER'S NAME AND INITIALS	
	A. ELECTRICAL DISTRIBUTION					
	B. WATER, SEWER, GAS, POL DISTRIBUTION					
	C. ENVIRONMENTAL (720) 847-5723					
	D. DRAINAGE SYSTEMS, PAVEMENTS					
	E. CATHODIC PROTECTION					
	F. ALARMS					
	G. HVAC					
	H. GROUNDS MAINTENANCE – COR (CONTRACT OFFICER REPRESENTATIVE)					
I. 140 TH CIVIL ENGINEERING (720) 847-9904						
ORGAINZATION		REMARKS			REVIEWER'S NAME / INITIALS	
11. SECURITY POLICE: Bldg 1028 (720) 847-9593						
12. 460 th SAFETY: Bldg 1030 (720) 847-6778						
13. COMMUNICATIONS Bldg 730 (720) 847-0999						
14. BASE OPERATIONS Bldg 909 Airfield Manager (720) 847-9731 or 6352						
15. FIRE DEPT Bldg 806 (720) 847-9926						
16. ADF Mr. Robert Lee (303) 677-3354 Maintenance Shop (303) 677-2026						
17. Commercial Utilities Company Ticket Number required (1-800-922-1987)						
18. OTHER (Specify)		ONLY VALID WITH Map ATTACHMENTS				
19. REQUESTED CLEARANCE		APPROVED		DISAPPROVED		
20. TYPED NAME AND SIGNATURE OF APPROVING OFFICER (Chief of Operations Flight/Deputy Chief of Operations Flight)						21. Date Signed
Robert Powers, Deputy Chief Operations Flight, 720-847-9913						

AF FORM 103 WORK CLEARANCE REQUEST INSTRUCTIONS**460th CE CUSTOMER SERVICE PH: 720-847-9913****DATE** _____

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 required work with key base activities and keep customer inconvenience to a minimum.

This form is required for any excavation on the installation of more than 4 inch(s) in depth.

1. The requester will provide necessary info for Sections 1-8 of the form, and provide the necessary work specifications for sections 9a-f. The designated area for locates must be clearly staked or marked with environmentally safe, water-soluble white paint. **INITIAL:** _____

2. The requester will visit or call the agencies listed on the AF Form 103 Sections 16 & 17 and obtain their coordination on the form before noon Wednesday the day before the meeting. **After obtaining these clearances the requester will attend the AF Form 103 Work Request Meeting on Thursday at 0900 hrs.** **INITIAL:** _____

3. Requestor must attend the Work Request coordination meeting specified by the 460 CES Customer Service representatives. Non-CES requestors must be accompanied by a CES advocate (COR/Inspector). A Customer Service representative will be in charge of getting the approving signature and then calling the requester to pick up the completed form. **INITIAL:** _____

4. Requests to locate utilities by Civil Engineering will be made 7 days prior to excavation. Large locate requests will be made 14 days prior. The requester will ensure utilities have been marked before excavation, **all locates are final. Requestor is responsible for maintaining all locates.** Should a need arise for re-locating utilities; request will be made using an AF Form 332 by the CES advocate (minimum 7 days to process). The markings of underground utilities shall be considered valid so long as the markings are clearly visible but not for more than 30 calendar days. **INITIAL:** _____

5. The requester must comply with all Environmental regulations (Fed, State, and Local) and procedures during performance of the work. By initialing, the requester acknowledges receipt of environmental notifications as indicated in Section 10, Block C of this form and will comply with environmental requirements. If there are any questions or concerns, please contact 460 CES/CEIE at 720-847-5723 during duty hours and the CE Customer Service section at 720-847-9913 after duty hours. **INITIAL:** Asbestos _____ Lead _____ or other _____

6. The requester will not proceed until all blocks on the form have been completed or marked as N/A by an approved authority and the request has been approved by the Operations Flight Chief or Deputy Operation Flight Chief or a designated representative. If any utilities are damaged without an approved AF Form 103 the contractor will be held responsible for the damage and repair. **The requester/equipment operator MUST carry/maintain a copy of approved AF Form 103 on site during the work.** **INITIAL:** _____

7. The requester will provide a copy of the completed AF Form 103, with attachments, to the contract inspector (if applicable) and will maintain a copy of the form on the job site. Upon the completion of installed new utilities the requester will provide updated as-built drawings to Mr. Delbert Brown, GeoBase Manager (847-9309). **INITIAL:** _____

8. It is the requester's responsibility to renew AF Form 103 before it expires. Do this by calling Customer Service at 720-847-9913 or stopping by the office. AF Form 103 is only valid for 30 days from signed date. If renewing after 30 days, a new AF Form 103 will be processed. **It's the responsibility of the contactor(s) to remove any/all locate markings upon job completion.** **INITIAL:** _____

9. **After the locates are performed, the excavator must exercise caution while excavating.** The marked facility should be within 18" of each side of the locate marks. If excavation is necessary within that area exposing the underground facility by manual excavation is suggested. The use of any power-operated earth-moving equipment can easily damage a facility. It can also disturb the facility by its weight and/or other characteristics of the equipment. **INITIAL:** _____

IN THE EVENT THAT A UTILITY LINE IS DAMAGED: The requester will immediately contact the Base Fire Department at 911 for any situation that requires emergency response. The requester will immediately notify the Customer Service section of CE at 720-847-9913 and the Contracting Officer or Inspector when any utility line is damaged. Other agencies listed on the AF Form 103 will be contacted by the requester as required. **INITIAL:** _____

AF 103 Revised Oct 2015

SECTION TABLE OF CONTENTS

DIVISION 31 - EARTHWORK

SECTION 31 63 29

DRILLED CONCRETE PIERS AND SHAFTS

11/19

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY CONTROL
 - 1.3.1 General
 - 1.3.2 Sequencing and Scheduling
 - 1.3.3 Inspection Criteria
 - 1.3.4 Qualification of Excavation Contractor
 - 1.3.5 Qualification of Professional Engineer
 - 1.3.6 Welding Qualifications
 - 1.3.7 Pre-Construction Conference
- 1.4 PROJECT CONDITIONS
 - 1.4.1 Existing Conditions
 - 1.4.2 Interruption of Existing Utilities
 - 1.4.3 Weather Limitations

PART 2 PRODUCTS

- 2.1 DESIGN REQUIREMENTS
 - 2.1.1 Assembly
- 2.2 EQUIPMENT
 - 2.2.1 Drilling and Excavation Equipment
- 2.3 MATERIALS
 - 2.3.1 Steel Reinforcement
 - 2.3.1.1 Deformed Steel Bars
 - 2.3.1.2 Plain Steel Wire
 - 2.3.2 Ready-Mix Concrete

PART 3 EXECUTION

- 3.1 PREPARATION
- 3.2 INSTALLATION
 - 3.2.1 Construction Criteria
 - 3.2.2 Excavation
 - 3.2.3 Steel Reinforcement
 - 3.2.4 Concrete Placement
- 3.3 FIELD QUALITY CONTROL
 - 3.3.1 Test Reports

-- End of Section Table of Contents --

SECTION 31 63 29

DRILLED CONCRETE PIERS AND SHAFTS
11/19

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(2010; Errata 2011) Specifications for Tolerances for Concrete Construction and Materials and Commentary
ACI 301	(2016) Specifications for Structural Concrete
ACI 304R	(2000; R 2009) Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	(2020) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting
ACI 318	(2014; Errata 1-2 2014; Errata 3-5 2015; Errata 6 2016; Errata 7-9 2017) Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)
ACI 336.1	(2001) Specification for the Construction of Drilled Piers
ACI SP-66	(2004) ACI Detailing Manual

AMERICAN 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 WELDING SOCIETY (AWS)

AWS A5.1/A5.1M	(2012) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1/D1.1M	(2020) Structural Welding Code - Steel
AWS D1.4/D1.4M	(2011) Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2021a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C39/C39M	(2021) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
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	(2020) Standard Specification for Portland Cement
ASTM C172	(2010) Standard Practice for Sampling Freshly Mixed Concrete

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	(2018) Manual of Standard Practice
------------	------------------------------------

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

FHWA NHI-10-016	(2010) Drilled Shafts: Construction Procedures and LRFD Design Methods
-----------------	--

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.651	Specific Excavation Requirements
-----------------	----------------------------------

1.2 SUBMITTALS

Government approval is required for submittals with a "G" 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

Installation Plan

SD-02 Shop Drawings

Drilled Shaft Diameters; G

Depth of Test Holes; G

Top and Bottom of Shaft Elevations; G

Steel Reinforcement; G

Anchor Bolt Locations; G

Accessories; G

SD-05 Design Data

Drilled Shaft Foundation Design Analysis; G

Mix Design Data; G

Recycled Content for Steel; S

SD-06 Test Reports

Soils Report; G

Ground Water Conditions

Penetration Test; G

Slump

Concrete; G

Compressive Strength; G

SD-07 Certificates

Bill of Lading for Ready-Mix Concrete Deliveries

Steel Reinforcement; G

Welding Certificates; G

Excavation and Drilling Equipment

Qualifications of Excavator; G

Qualifications of Engineer; G

1.3 QUALITY CONTROL

1.3.1 General

Install drilled shaft foundations in accordance with applicable requirements as described by ACI 336.1, and FHWA NHI-10-016.

1.3.2 Sequencing and Scheduling

Submit a detailed installation plan describing the schedule for drilling and/or excavation, installation of steel reinforcement and concrete placement with anticipated site conditions so that each excavated shaft is

poured the same day that the drilling is performed.

1.3.3 Inspection Criteria

Design inspection activities to minimize delays while insuring the intent of the Industry Standard Specifications.

1.3.4 Qualification of Excavation Contractor

An experienced excavator with five (5) years experience and licensed in the State of Colorado, specialized in excavating and installing work similar in material, design, and extent to that indicated for this Project. Submit certificates substantiating the Qualifications of Excavator.

1.3.5 Qualification of Professional Engineer

Provide engineering services by an authorized engineer currently licensed in the State of Colorado; having a minimum of four (4) years experience as an engineer knowledgeable in drilled shaft foundation design analysis, protocols and procedures for the ACI 336.1, FHWA NHI-10-016, ASCE 7-16, and the Colorado Building Code. Submit certificates substantiating the Qualifications of Engineer.

1.3.6 Welding Qualifications

Provide and maintain qualified procedures and personnel according to AWS D1.1/D1.1M, AWS D1.4/D1.4M, and AWS A5.1/A5.1M. Submit Welding Certificates to the Contracting Officer.

1.3.7 Pre-Construction Conference

After submittals are received and approved but before drilled shaft excavation and foundation work, including associated work, is performed, the Contracting Officer will hold a pre-construction conference to review the following:

- a. The drawings, specifications and the geotechnical report.
- b. Finalize construction schedule and verify availability of materials, Excavator's personnel, equipment, and facilities needed to make progress and avoid delays.
- c. Methods and procedures related to drilled shaft foundation installation, including engineer's written instructions.
- d. Support conditions for compliance with requirements, including alignment between foundation system and erection of structural members.
- e. Governing regulations and requirements for, certificates, insurance, tests and inspections if applicable.
- f. Temporary protection requirements for foundation assembly during and after installation.

1.4 PROJECT CONDITIONS

1.4.1 Existing Conditions

Locate existing underground utilities before excavating drilled shaft foundations. If existing utilities are to remain in place, provide protection during drilled shaft operations.

1.4.2 Interruption of Existing Utilities

Do not interrupt any utility to occupied facilities unless directed in writing by the Contracting Officer.

1.4.3 Weather Limitations

Proceed with installation preparation only when existing and forecasted weather conditions permit work to proceed without water entering into the area of excavation.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

Submit design data for the following:

- a. Drilled shaft foundation design analysis to include, but not limited to the following:
 - (1) Applicable Building code criteria for the excavation's geographic area
 - (2) Dead and Live Loads
 - (3) Compressive and Lateral Loads
 - (4) Collateral Loads
 - (5) Foundation Loads
 - (6) Bearing strata
 - (7) Casing description
- b. Mix design data in accordance with paragraph READY-MIX CONCRETE accompanied by the Bill of Lading for Ready Mix Concrete deliveries.

2.1.1 Assembly

Installation drawings are to include, but not limited to, the following items indicating a completely dimensioned layout and location of drilled shafts and concrete placement for foundation system. Submit detailed shop drawings for the following:

- a. Drilled shaft diameters
- b. Depth of test holes
- c. Top and bottom of shaft elevations

- d. Steel reinforcement
- e. Anchor bolt locations
- f. Accessories

2.2 EQUIPMENT

2.2.1 Drilling and Excavation Equipment

Provide drilling and excavation equipment having adequate capacity, including but not limited to, power, torque and down thrust to excavate a hole of diameter and depth indicated. Also provide excavation and over-reaming tools of adequate design, size and strength to perform the work indicated.

Provide special drilling equipment including, but not limited to, rock core barrels, rock tools, air tools and other equipment as necessary to construct the shaft excavation to the size and depth indicated when materials encountered can not be drilled using earth augers and/or over-reaming tools.

Submit certificates substantiating appropriate selection of excavation and drilling equipment.

2.3 MATERIALS

2.3.1 Steel Reinforcement

For products in this section, where applicable and to extent allowed by performance criteria, provide minimum 75 percent recycled content for steel.

2.3.1.1 Deformed Steel Bars

Steel bars conforming to ASTM A615/A615M, Grade 60 ksi and ACI 318.

2.3.1.2 Plain Steel Wire

Steel wire conforming to ASTM A1064/A1064M.

2.3.2 Ready-Mix Concrete

Ready-Mix concrete and mix design conforming to ACI 117, ACI 301, and ACI 304R, minimum compressive strength 5,500 psi at 28 days. Slump results between 5 to 6 inches, according to ASTM C143/C143M.

Portland cements conforming to ASTM C150/C150M, Type II. Provide one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

Potable water conforming to ASTM C94/C94M.

Measure, batch, mix and deliver concrete according to ASTM C94/C94M and furnish batch ticket information.

PART 3 EXECUTION

3.1 PREPARATION

Protect existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by drilled shaft foundation operations.

Provide Fall Protection as required by Section 01 35 26 GOVERNMENTAL SAFETY REQUIREMENTS and 29 CFR 1926.651.

3.2 INSTALLATION

3.2.1 Construction Criteria

Provide equipment for checking the dimensions and alignment of each shaft excavation. Determine dimensions and alignment jointly with the contractor and engineer. Measure final shaft depths with appropriate weighted tape measure or other approved method after cleaning.

Provide and install monolithically cast-in-place concrete drilled shaft foundation to the sizes indicated.

Provide and install straight cylindrical shaft foundation of the type indicated.

Tolerances:

- a. Maximum variation of the center of any shaft foundation from the required location: 3 inches, measured at the ground surface.
- b. Bottom Diameter: Minus zero, plus 6 inches, measured in any direction.
- c. Maximum variation from plumb: 1:40.
- d. Maximum bottom level: Plus or minus 2 inches.

3.2.2 Excavation

Accomplish excavation of shaft foundations by standard excavation methods including, but not limited to, conventional augers fitted with soil and/or rock teeth, or under-reaming tools attached to drilling equipment of adequate size, power, torque and down thrust necessary for the work.

Perform excavation through whatever materials that are encountered to the dimensions, depths and applicable ACI 336.1 tolerances.

Protect excavated walls with temporary watertight steel casings of sufficient length to prevent water intrusion, cave-ins, displacement of surrounding earth, and injury to personnel and damage to construction operations.

Excavate shafts for drilled foundations to indicated elevations. Remove loose debris, materials and/or muck to make bottom surfaces level within ACI 336.1 tolerances.

Remove water from excavated shaft prior to concrete placement.

3.2.3 Steel Reinforcement

Comply with recommendations in the CRSI "Manual of Standard Practice" CRSI 10MSP for fabricating, placing and supporting reinforcement. Shop fabricate steel reinforcement in accordance with ACI SP-66.

When practicable, deliver the reinforcement cage assembly to the jobsite as a complete unit ready for installation. Should it be necessary to make any additional connections and/or splices, provide as indicated on the approved shop drawings, at-grade level prior to lowering the complete assembly into the hole.

Clean reinforcement of loose rust, mill scale, earth and other foreign materials. Do not tack weld crossing reinforcing bars. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

Lower reinforcement steel into the hole in such a manner as to prevent damage to the walls of the excavation. Place, tie and/or clip cage symmetrically about the axis of the shaft. Use centering devices securely attached to the cage to clear the shaft walls and maintain the cage in place throughout the concrete placement operations.

Cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between reinforcing and embedded items, notify the Contracting Officer in order to reconcile conflicts before concrete placement. Position and support anchors and embedded items with appropriate accessories.

Use templates to set anchor bolts, leveling plates and other accessories required for structure erection. Provide blocking and/or holding devices to maintain required anchoring positions during final concrete placement.

3.2.4 Concrete Placement

Keep all equipment, including but not limited to, mixers, pumps, hoses, tools and screeds clean and free of set concrete throughout the placement operation.

Convey concrete from the mixer to place of deposit by best industry methods that prevents segregation and loss of material. Size and design the equipment for conveying concrete to ensure uniform, continuous placement of concrete.

Place concrete in accordance with ACI 318.

Place concrete in a continuous operation and without segregation into dry excavations whenever possible after inspection and written approval by the Contracting Officer. Use all practicable means to obtain a dry excavation before and during concrete placement.

Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. When hot weather conditions exist that would impair quality and strength of placed concrete, comply with ACI 305R. Comply with ACI 306.1 for cold-weather protection.

A minimum of 50 percent of the base for each shaft is to be less than 1/2 inch of sediment at the time of concrete placement. Maximum depth of sediment or debris at any place on the base of the shaft is not to exceed 1-1/2 inches. Shaft cleanliness is to be determined by the engineer by

visual inspection.

3.3 FIELD QUALITY CONTROL

3.3.1 Test Reports

As a minimum, submit the following test reports and data.

- a. Soils Report
- b. Ground Water conditions
- c. Penetration Test
- d. Slump
- e. Concrete
- f. Compressive Strength

Sample and test concrete for quality control during placement.

Sample freshly placed concrete for testing in accordance with ASTM C172.

Make concrete test specimens for compressive strength at 7 and 28 days for each design mix conforming to ASTM C31/C31M. Compression test concrete in accordance with ASTM C39/C39M.

Test Slump at plant for each design mix in accordance with ASTM C143/C143M.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 05 33

LANDSCAPE ESTABLISHMENT

08/17

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Pesticide
 - 1.2.2 Stand of Turf
 - 1.2.3 Planter Beds
- 1.3 RELATED REQUIREMENTS
- 1.4 SUBMITTALS
- 1.5 DELIVERY, STORAGE AND HANDLING
 - 1.5.1 Delivery
 - 1.5.2 Storage
 - 1.5.2.1 Fertilizer, Lime and Mulch Storage
 - 1.5.2.2 Antidesiccant's Storage
 - 1.5.3 Handling

PART 2 PRODUCTS

- 2.1 POST-PLANT FERTILIZER
 - 2.1.1 Granular Fertilizer
- 2.2 WATER
- 2.3 MULCHES TOPDRESSING
 - 2.3.1 Inert Mulch Materials
 - 2.3.2 Organic Mulch Materials
 - 2.3.3 Recycled Organic Mulch
- 2.4 PESTICIDES

PART 3 EXECUTION

- 3.1 EXTENT OF WORK
 - 3.1.1 Policing
- 3.2 IRRIGATION ESTABLISHMENT PERIOD
 - 3.2.1 Water Restrictions
 - 3.2.2 Fire Hydrants
- 3.3 GROUNDCOVER ESTABLISHMENT PERIOD
 - 3.3.1 Frequency of Maintenance
 - 3.3.2 Promotion of Growth
 - 3.3.3 Mowing
 - 3.3.3.1 Native Grasses
 - 3.3.4 Edging and Trimming
 - 3.3.5 Watering
 - 3.3.6 Clearance Area
 - 3.3.7 Replanting
 - 3.3.8 Final Inspection and Acceptance
- 3.4 EXTERIOR PLANT ESTABLISHMENT PERIOD
 - 3.4.1 Frequency of Maintenance

- 3.4.2 Promotion of Plant Growth and Vigor
- 3.4.3 Planter Bed Maintenance
 - 3.4.3.1 Shrub Selective Maintenance
 - 3.4.3.2 Tree Maintenance
- 3.4.4 Removal of Dying or Dead Plants
- 3.4.5 Tracking of Unhealthy Plants
- 3.4.6 Final Inspection
 - 3.4.6.1 Total Plants on Site
 - 3.4.6.2 Mulching and Weeding
 - 3.4.6.3 Tree Supports
 - 3.4.6.4 Remedial Work
- 3.5 FIELD QUALITY CONTROL
 - 3.5.1 Maintenance Inspection Report
 - 3.5.2 Plant Quantities
 - 3.5.3 Tree Staking and Guying Removal

-- End of Section Table of Contents --

SECTION 32 05 33

LANDSCAPE ESTABLISHMENT
08/17

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D6155 (2019) Nontraditional Coarse Aggregate for Bituminous Paving Mixtures

TREE CARE INDUSTRY ASSOCIATION (TCIA)

TCIA Z133 (2017) American National Standard for Arboricultural Operations - Pruning, Repairing, Maintaining, and Removing Trees, and Cutting Brush - Safety Requirements

1.2 DEFINITIONS

1.2.1 Pesticide

Any substance or mixture of substances, including biological control agents, that may prevent, destroy, repel, or mitigate pests and are specifically labeled for use by the U.S. Environmental Protection Agency (EPA). Also, any substance used as a plant regulator, defoliant, disinfectant, or biocide. Examples of pesticides include fumigants, herbicides, insecticides, fungicides, nematocides, molluscicides and rodenticides.

1.2.2 Stand of Turf

95 percent ground cover of the established species.

1.2.3 Planter Beds

A planter bed is defined as an area containing one or a combination of the following plant types: trees, shrubs, vines, wildflowers, annuals, perennials, ground cover, and a mulch topdressing excluding turf.

1.3 RELATED REQUIREMENTS

Section 32 92 19 SEEDING applies to this section for installation of seed requirements, with additions and modifications herein.

Section 32 93 00 EXTERIOR PLANTS applies to this section for installation of trees and shrubs 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 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

Integrated Pest Management Plan; G

SD-03 Product Data

Fertilizer; G

Mulches Topdressing

Organic Mulch Materials

SD-07 Certificates

Maintenance Inspection Report

Plant Quantities; G

SD-11 Closeout Submittals

Tree Staking and Guying Removal

1.5 DELIVERY, STORAGE AND HANDLING

1.5.1 Delivery

Deliver fertilizer to the site in original containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws.

1.5.2 Storage

1.5.2.1 Fertilizer, Lime and Mulch Storage

Store material in designated areas. Store lime and fertilizer in cool, dry locations away from contaminants.

1.5.2.2 Antidesiccant's Storage

Do not store with fertilizers or other landscape maintenance materials.

1.5.3 Handling

Do not drop or dump materials from vehicles.

PART 2 PRODUCTS

2.1 POST-PLANT FERTILIZER

2.1.1 Granular Fertilizer

Organic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients , as per independent laboratory soil test and recommendations for fertilizers. The following fertilizer shall be assumed for bidding purposes at rates per manufacturer's recommendation.

- 10 percent available nitrogen
- 10 percent available phosphorus
- 10 percent available potassium

2.2 WATER

Source of water must be approved by the Contracting Officer, and be of suitable quality for irrigation.

2.3 MULCHES TOPDRESSING

Free from noxious weeds, mold, or other deleterious materials.

2.3.1 Inert Mulch Materials

Provide riverbank stone, complying with ASTM D6155, ranging in size from 1 to 6 inches.

2.3.2 Organic Mulch Materials

Provide wood chips or shredded hardwood.

2.3.3 Recycled Organic Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 2-1/2 by 2-1/2 inch screen. Clean recycled mulch of all sticks a minimum one inch in diameter and plastic materials a minimum 3 inch length. The material must be treated to retard the growth of mold and fungi.

2.4 PESTICIDES

Submit an Integrated Pest Management Plan, including weed and pest management strategies proposed alternatives to herbicides and pesticides.

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide landscape construction maintenance to include mowing, edging, overseeding, fertilizing, watering, weeding, pruning, and stake and guy adjusting for all newly installed landscape areas, unless indicated otherwise, and at all areas inside or outside the limits of the construction that are disturbed by the Contractor's operations.

3.1.1 Policing

Police all landscaped areas. Policing includes removal of leaves, branches and limbs regardless of length or diameter, dead vegetation, paper, trash, cigarette butts, garbage, rocks or other debris. Policing must extend to both sides of fencing or walls. Collected debris must be promptly removed and disposed of at an approved disposal site.

3.2 IRRIGATION ESTABLISHMENT PERIOD

3.2.1 Water Restrictions

Abide by state, local or other water conservation regulations in force during the establishment period.

3.2.2 Fire Hydrants

To use a fire hydrant for irrigation, obtain prior clearance from the Contracting Officer and provide the tools and connections approved for use on fire hydrants. If a fire hydrant is used, Provide a reduced pressure backflow preventer for each connection between hose and fire hydrant. Backflow preventer used must be tested once per month by a certified backflow preventer tester.

3.3 GROUNDCOVER ESTABLISHMENT PERIOD

Groundcover establishment period will commence on the date that inspection by the Contracting Officer shows that the new turf furnished under this contract has been satisfactorily installed to a 95 percent stand of coverage. The establishment period must continue for a period of 365 days.

3.3.1 Frequency of Maintenance

Begin maintenance immediately after turf has been installed. Inspect areas once a week during the installation and establishment period and perform needed maintenance promptly.

3.3.2 Promotion of Growth

Maintain groundcover in a manner that promotes proper health, growth, natural color. Turf must have a neat uniform manicured appearance, free of bare areas, ruts, holes, weeds, pests, dead vegetation, debris, and unwanted vegetation that present an unsightly appearance. Mow, remove excess clippings, eradicate weeds, water, fertilize, overseed, and perform other operations necessary to promote growth, as approved by Contracting Officer and consistent with approved Integrated Pest Management Plan. Remove noxious weeds common to the area from planting areas by mechanical means.

3.3.3 Mowing

3.3.3.1 Native Grasses

Mow above height of native grass seedlings approximately 3.5 to 4 inches. Mow during spring or early summer. Do not mow after early summer during the second growing season.

3.3.4 Edging and Trimming

Perimeter of planter bed edges, sidewalks, driveways, curbs, and other paved surfaces must be edged. Uniformly edge these areas to prevent encroachment of vegetation onto paved surfaces and to provide a clear cut division line between planter beds, turf, and ground cover. Edging is to be accomplished in a manner that prevents scalping, rutting, bruising, uneven and rough cutting. Perform edging on the same day that turf is mowed. Use of string line trimmers is permitted in "soft" areas such as an edge between turfgrass and a planter bed. Exercise care to avoid damage to any plant materials, structures, and other landscape features.

Trimming around trees, fences, poles, walls, and other similar objects is to be accomplished to match the height and appearance of surrounding mowed turf growth. Trimming must be performed on the same day the turf's mowed. Care must be exercised to avoid "Girdling" trees located in turf areas. The use of protective tree collars on trees in turf areas may be utilized as a temporary means to avoid injury to tree trunks. At the end of the plant establishment period Contractor will be responsible for removing all protective tree collars.

3.3.5 Watering

Perform irrigation in a manner that promotes the health, growth, color and appearance of cultivated vegetation and that complies with all Federal, State, and local water agencies and authorities directives. The Contractor must be responsible to prevent over watering, water run-off, erosion, and ponding due to excessive quantities or rate of application. Abide by state, local or other water conservation regulations or restrictions in force during the establishment period..

3.3.6 Clearance Area

Trees located in native grass areas must be maintained with a growth free clearance of 2 feet, 6 inches from the tree trunk base. The use of mechanical weed whips to accomplish the turf growth free bed area is prohibited.

3.3.7 Replanting

Replant in accordance with Section 32 92 19 SEEDING and within specified planting dates areas which do not have a satisfactory stand of turf.

3.3.8 Final Inspection and Acceptance

Final inspection will be make upon written request from the Contractor at least 10 days prior to the last day of the turf establishment period. Final turf acceptance will be based upon a satisfactory stand of turf.

3.4 EXTERIOR PLANT ESTABLISHMENT PERIOD

The exterior plant establishment period will commence on the date that inspection by the Contracting Officer shows that the new plants furnished under this contract have been satisfactorily installed and must continue for a period of 365 days.

3.4.1 Frequency of Maintenance

Begin maintenance immediately after plants have been installed. Inspect

exterior plants at least once a week during the installation and establishment period and perform needed maintenance promptly.

3.4.2 Promotion of Plant Growth and Vigor

Water, prune, fertilize, mulch, adjust stakes, guys and turnbuckles, eradicate weeds and perform other operations necessary to promote plant growth, and vigor.

3.4.3 Planter Bed Maintenance

Planter beds must be weeded, fertilized, irrigated, kept pest free, turf free, pruned, and mulch levels maintained. Planter beds will not be allowed to encroach into turf areas. A definite break must be maintained between turf areas and planter beds.

3.4.3.1 Shrub Selective Maintenance

In addition to the above requirements, shrubs must be selectively pruned, and shaped for health and safety when the following conditions exist: Remove growth in front of windows, over entrance ways or walks, and any growth which will obstruct vision at street intersections or of security personnel; Remove dead, damaged or diseased branches or limbs; where shrub growth obstructs pedestrian walkways; where shrub growth is found growing against or over structures; where shrub growth permits concealment of unauthorized persons. Dispose of all pruning debris in a proper manner.

3.4.3.2 Tree Maintenance

Tree maintenance must include adjustment of stakes, ties, guy supports and turnbuckles, watering, fertilizing, pest control, mulching, pruning for health and safety. Inspect and adjust stakes, ties, guy supports and turnbuckles to avoid girdling and promote natural development. All trees within the project boundaries, regardless of caliper, must be selectively pruned for safety and health reasons. These include but are not limited to removal of dead and broken branches and correction of structural defects. Prune trees according to their natural growth characteristics leaving trees well shaped and balanced. Pruning of all trees including palm trees must be accomplished by or in the presence of a certified member of the International Society of Arboriculture and in accordance with TCIA Z133. All pruning debris generated must be disposed of in a proper manner.

3.4.4 Removal of Dying or Dead Plants

Remove dead and dying plants and provide new plants immediately upon commencement of the specified planting season, and replace stakes, guys, mulch and eroded earth mound water basins. Provide an additional 90 day establishment period for replacement plants beyond the original warranty period. A tree must be considered dying or dead when the main leader has died back, or a minimum of 20 percent of the crown has died. A shrub or ground cover must be considered dying or dead when a minimum of 20 percent of the plant has died. This condition must be determined by scraping on a branch an area 1/16 inch square, maximum, to determine the cause for dying plant material and must provide recommendations for replacement. The Contractor must determine the cause for dying plant material and provide recommendations for replacement.

3.4.5 Tracking of Unhealthy Plants

Note plants not in healthy growing condition, as determined by the Contracting Officer, and as soon as seasonal conditions permit, remove and replace with plants of the same species and sizes as originally specified. Install replacement plantings in accordance with Section 32 93 00 EXTERIOR PLANTS.

3.4.6 Final Inspection

Final inspection will be made upon written request from the Contractor at least 10 days prior to the last day of the establishment period. Final inspection will be based upon satisfactory health and growth of plants and on the following:

3.4.6.1 Total Plants on Site

Plants have been accepted and required number of replacements have been installed.

3.4.6.2 Mulching and Weeding

Planter beds and earth mound water basins are properly mulched and free of weeds.

3.4.6.3 Tree Supports

Stakes guys guys and turnbuckles are in good condition.

3.4.6.4 Remedial Work

Remedial measures directed by the Contracting Officer to ensure plant material survival and promote healthy growth have been completed.

3.5 FIELD QUALITY CONTROL

3.5.1 Maintenance Inspection Report

Provide maintenance inspection report to assure that landscape maintenance is being performed in accordance with the specifications and in the best interest of plant growth and survivability. Site observations must be documented at the start of the establishment period, then quarterly following the start, and at the end of establishment period. Submit results of site observation visits to the Contracting Officer within 7 calendar days of each site observation visit.

3.5.2 Plant Quantities

Provide Contracting Officer with the number of plant quantities. In addition, provide total exterior area of hardscape and landscaping such as turf and total number of shrubs.

3.5.3 Tree Staking and Guying Removal

Provide a certified letter that all stakes and guys are removed from all project trees at the end of the establishment period.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 11 23

AGGREGATE BASE COURSES

08/17

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Aggregate Base Course
 - 1.2.2 Graded-Crushed Aggregate Base Course
 - 1.2.3 Degree of Compaction
- 1.3 SUBMITTALS
- 1.4 EQUIPMENT, TOOLS, AND MACHINES
- 1.5 QUALITY ASSURANCE
 - 1.5.1 Sampling
 - 1.5.2 Tests
 - 1.5.2.1 Sieve Analysis
 - 1.5.2.2 Liquid Limit and Plasticity Index
 - 1.5.2.3 Moisture-Density Determinations
 - 1.5.2.4 Field Density Tests
- 1.6 ENVIRONMENTAL REQUIREMENTS

PART 2 PRODUCTS

- 2.1 AGGREGATES
 - 2.1.1 Gradation Requirements
- 2.2 LIQUID LIMIT AND PLASTICITY INDEX
- 2.3 TESTS, INSPECTIONS, AND VERIFICATIONS
 - 2.3.1 Initial Tests
 - 2.3.2 Approval of Material

PART 3 EXECUTION

- 3.1 GENERAL REQUIREMENTS
- 3.2 OPERATION OF AGGREGATE SOURCES
- 3.3 STOCKPILING MATERIAL
- 3.4 PREPARATION OF UNDERLYING COURSE OR SUBGRADE
- 3.5 GRADE CONTROL
- 3.6 MIXING AND PLACING MATERIALS
- 3.7 LAYER THICKNESS
- 3.8 COMPACTION
- 3.9 EDGES OF BASE COURSE
- 3.10 FINISHING
- 3.11 SMOOTHNESS TEST
- 3.12 FIELD QUALITY CONTROL
 - 3.12.1 In-Place Tests
 - 3.12.2 Approval of Material
- 3.13 TRAFFIC
- 3.14 MAINTENANCE
- 3.15 DISPOSAL OF UNSATISFACTORY MATERIALS

-- End of Section Table of Contents --

SECTION 32 11 23

AGGREGATE BASE COURSES
08/17

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T 180 (2017) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

AASHTO T 224 (2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C117 (2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C136/C136M (2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM D75/D75M (2019) Standard Practice for Sampling Aggregates

ASTM D1556/D1556M (2015; E 2016) Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method

ASTM D1557 (2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³) (2700 kN-m/m³)

ASTM D2167 (2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method

ASTM D2487 (2017; E 2020) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

ASTM D4318 (2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and

Plasticity Index of Soils

ASTM D6938 (2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

ASTM E11 (2020) Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.2 Graded-Crushed Aggregate Base Course

Graded-crushed aggregate (GCA) base course is well graded, crushed, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.3 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum dry density. Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve will be expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" 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

Plant, Equipment, and Tools; G

SD-06 Test Reports

Initial Tests; G

In-Place Tests; G

1.4 EQUIPMENT, TOOLS, AND MACHINES

All plant, equipment, and tools used in the performance of the work will be subject to approval by the Contracting Officer before the work is

started. Maintain all plant, equipment, and tools in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Use equipment capable of minimizing segregation, producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.5 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor. Perform sampling and testing using a laboratory approved in accordance with Section 01 45 00.00 10 QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements and perform testing at the specified frequency. The Contracting Officer may specify the time and location of the tests. Furnish copies of test results to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Take samples for laboratory testing in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

1.5.2.1 Sieve Analysis

Perform sieve analysis in conformance with ASTM C117 and ASTM C136/C136M using sieves conforming to ASTM E11. .

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D4318.

1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture content in accordance with paragraph DEGREE OF COMPACTION.

1.5.2.4 Field Density Tests

Measure field density in accordance with ASTM D1556/D1556M, ASTM D2167 or ASTM D6938. For the method presented in ASTM D1556/D1556M use the base plate as shown in the drawing. For the method presented in ASTM D6938 check the calibration curves and adjust them, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D6938 result in a wet unit weight of soil and ASTM D6938 will be used to determine the moisture content of the soil. Also check the calibration curves furnished with the moisture gauges along with density calibration checks as described in ASTM D6938. Make the calibration checks of both the density and moisture gauges using the prepared containers of material method, as described in paragraph Calibration of ASTM D6938, on each different type of material being tested at the beginning of a job and at intervals as directed. Submit calibration curves and related test results prior to using the device or equipment being calibrated.

1.6 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.1 AGGREGATES

Provide ABC per CDOT Section 703.04 for Class 4.

2.1.1 Gradation Requirements

Provide ABC gradation per CDOT Standards Section 703, table 703-2 Class 4 except that the max percentage retained on the #200 sieve shall be 8 percent.

2.2 LIQUID LIMIT AND PLASTICITY INDEX

Apply liquid limit and plasticity index requirements to the completed course and to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the No. 40 sieve must be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

2.3 TESTS, INSPECTIONS, AND VERIFICATIONS

2.3.1 Initial Tests

Perform one of each of the following tests, on the proposed material prior to commencing construction, to demonstrate that the proposed material meets all specified requirements when furnished. Complete this testing for each source if materials from more than one source are proposed.

- a. Sieve Analysis.
- b. Liquid limit and plasticity index.
- c. Moisture-density relationship.
- d. Wear.

Submit certified copies of test results for approval not less than 30 days before material is required for the work.

2.3.2 Approval of Material

Tentative approval of material will be based on initial test results.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC is constructed in more than one layer, clean the previously constructed layer of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas

where power cleaning is not practicable. Provide adequate drainage during the entire period of construction to prevent water from collecting or standing on the working area.

3.2 OPERATION OF AGGREGATE SOURCES

Condition aggregate sources on private lands in accordance with local laws or authorities.

3.3 STOCKPILING MATERIAL

Clear and level storage sites prior to stockpiling of material. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Stockpile aggregates on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Stockpile materials obtained from different sources separately.

3.4 PREPARATION OF UNDERLYING COURSE OR SUBGRADE

Clean the underlying course or subgrade of all foreign substances prior to constructing the base course(s). Do not construct base course(s) on underlying course or subgrade that is frozen. Construct the surface of the underlying course or subgrade to meet specified compaction and surface tolerances. Correct ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the specified requirements set forth herein by loosening and removing soft or unsatisfactory material and adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D2487, stabilize the surface prior to placement of the base course(s). Do not allow traffic or other operations to disturb the finished underlying course and maintain in a satisfactory condition until the base course is placed.

3.5 GRADE CONTROL

Provide a finished and completed base course conforming to the lines, grades, and cross sections shown. Place line and grade stakes as necessary for control.

3.6 MIXING AND PLACING MATERIALS

Mix the coarse and fine aggregates in a stationary plant. Make adjustments in mixing procedures or in equipment, as directed, to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory base course meeting all requirements of this specification. Place the mixed material on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. Place the layers so that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the base course is placed in more than one layer, clean the previously constructed layers of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Make adjustments in placing procedures or equipment as may be directed by the Contracting Officer to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable base course.

3.7 LAYER THICKNESS

Compact the completed base course to the thickness indicated. No individual layer may be thicker than 6 inches nor be thinner than 3 inches in compacted thickness. Compact the base course(s) to a total thickness that is within 1/2 inch of the thickness indicated. Where the measured thickness is more than 1/2 inch deficient, correct such areas by scarifying, adding new material of proper gradation, reblading, and recompacting as directed. Where the measured thickness is more than 1/2 inch thicker than indicated, the course will be considered as conforming to the specified thickness requirements. The average job thickness will be the average of all thickness measurements taken for the job and must be within 1/4 inch of the thickness indicated. Measure the total thickness of the base course at intervals of one measurement for each 500 square yards of base course. Measure total thickness using 3 inch diameter test holes penetrating the base course.

3.8 COMPACTION

Compact each layer of the base course, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in this Section. Begin rolling at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Slightly vary the length of alternate trips of the roller. Adjust speed of the roller as needed so that displacement of the aggregate does not occur. Compact mixture with hand-operated power tampers in all places not accessible to the rollers. Continue compaction until each layer is compacted through the full depth to at least 95 percent of laboratory maximum density. Make such adjustments in compacting or finishing procedures as may be directed by the Contracting Officer to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory base course. Remove any materials found to be unsatisfactory and replace with satisfactory material or rework, as directed, to meet the requirements of this specification.

3.9 EDGES OF BASE COURSE

Place approved material along the outer edges of the base course in sufficient quantity to compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, simultaneously roll and compact at least a 2 foot width of this shoulder material with the rolling and compacting of each layer of the base course, as directed.

3.10 FINISHING

Finish the surface of the top layer of base course after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Do not add thin layers of material to the top layer of base course to meet grade. If the elevation of the top layer of base course is 1/2 inch or more below grade, scarify the top layer to a depth of at least 3 inches and blend new material in and compact to bring to grade. Make adjustments to rolling and finishing procedures as directed by the Contracting Officer to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic

marked prior to completion, scarify the unsatisfactory portion and rework and recompact it or replace as directed.

3.11 SMOOTHNESS TEST

Construct the top layer so that the surface shows no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Also take measurements perpendicular to the centerline at 50 foot intervals. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.12 FIELD QUALITY CONTROL

3.12.1 In-Place Tests

Perform each of the following tests on samples taken from the placed and compacted ABC . Take samples and test at the rates indicated.

- a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 250 square yards, or portion thereof, of completed area.
- b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 500 square yards, or portion thereof, of material placed.
- c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.
- d. Measure the thickness of the base course at intervals providing at least one measurement for each 500 square yards of base course or part thereof. Measure the thickness using test holes, at least 3 inch in diameter through the base course.

3.12.2 Approval of Material

Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and fully compacted course(s).

3.13 TRAFFIC

Completed portions of the base course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Do not allow heavy equipment on the completed base course except when necessary for construction. When it is necessary for heavy equipment to travel on the completed base course, protect the area against marring or damage to the completed work.

3.14 MAINTENANCE

Maintain the base course in a satisfactory condition until the full pavement section is completed and accepted. Immediately repair any defects and repeat repairs as often as necessary to keep the area intact. Retest any base course that was not paved over prior to the onset of winter to verify that it still complies with the requirements of this specification. Rework or replace any area of base course that is damaged

as necessary to comply with this specification.

3.15 DISPOSAL OF UNSATISFACTORY MATERIALS

Dispose of any unsuitable materials that have been removed outside the limits of Government-controlled land. No additional payments will be made for materials that have to be replaced.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 12 16.16

ROAD-MIX ASPHALT PAVING

11/20

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 ACCEPTANCE
 - 1.3.1 Acceptability of Work
 - 1.3.2 Acceptance Requirements
 - 1.3.3 Pavement Lots
 - 1.3.4 Sublot Sampling
 - 1.3.5 Additional Sampling and Testing
 - 1.3.6 Theoretical Maximum Density (TMD)
 - 1.3.7 Laboratory Air Voids
 - 1.3.7.1 Tolerance
 - 1.3.7.2 Calculating Laboratory Air Voids
 - 1.3.8 In-place Density
 - 1.3.8.1 Tolerance
 - 1.3.9 Surface Smoothness
 - 1.3.9.1 Smoothness Requirements
 - 1.3.9.1.1 Straightedge Testing
 - 1.3.9.2 Testing Method
 - 1.3.9.2.1 Straightedge Testing
 - 1.3.9.2.2 Bumps ("Must Grind" Areas)
 - 1.3.10 Plan Grade
 - 1.3.11 Laboratory Accreditation and Validation
- 1.4 ENVIRONMENTAL REQUIREMENTS

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Asphalt Mixing Plant
 - 2.1.1.1 Truck Scales
 - 2.1.1.2 Inspection of Plant
 - 2.1.1.3 Storage bins
 - 2.1.2 Hauling Equipment
 - 2.1.3 Asphalt Pavers
 - 2.1.3.1 Receiving Hopper
 - 2.1.3.2 Automatic Grade Controls
 - 2.1.4 Rollers
 - 2.1.5 Diamond Grinding
- 2.2 AGGREGATES
- 2.3 ASPHALT CEMENT BINDER
- 2.4 MIX DESIGN
 - 2.4.1 JMF Requirements
 - 2.4.2 Adjustments to JMF
- 2.5 RECYCLED HOT MIX ASPHALT

PART 3 EXECUTION

- 3.1 CONTRACTOR QUALITY CONTROL
 - 3.1.1 General Quality Control Requirements
 - 3.1.2 Testing Laboratory
 - 3.1.3 Quality Control Testing
 - 3.1.3.1 Asphalt Content
 - 3.1.3.2 Aggregate Properties
 - 3.1.3.3 Moisture Content of Aggregate
 - 3.1.3.4 Moisture Content of Asphalt Mixture
 - 3.1.3.5 Temperatures
 - 3.1.3.6 VMA
 - 3.1.3.7 In-Place Density
 - 3.1.3.8 Additional Testing
 - 3.1.3.9 QC Monitoring
 - 3.1.4 Sampling
 - 3.1.5 Control Charts
- 3.2 PREPARATION OF ASPHALT BINDER MATERIAL
- 3.3 PREPARATION OF MINERAL AGGREGATE
- 3.4 PREPARATION OF ASPHALT MIXTURE
- 3.5 PREPARATION OF THE UNDERLYING SURFACE
- 3.6 TRANSPORTING AND PLACING
 - 3.6.1 Transporting
 - 3.6.2 Placing
- 3.7 COMPACTION OF MIXTURE
 - 3.7.1 General
 - 3.7.2 Segregation
- 3.8 JOINTS
 - 3.8.1 Transverse Joints
 - 3.8.2 Longitudinal Joints

-- End of Section Table of Contents --

SECTION 32 12 16.16

ROAD-MIX ASPHALT PAVING
11/20

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 156	(2013; R 2017) Standard Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
AASHTO T 304	(2011; R 2015) Standard Method of Test for Uncompacted Void Content of Fine Aggregate
AASHTO T 329	(2015) Standard Test Method for Moisture Content of Hot Mix Asphalt (HMA) by Oven Method

ASPHALT INSTITUTE (AI)

AI MS-2	(2015) Asphalt Mix Design Methods
---------	-----------------------------------

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2017) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C127	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C128	(2015) Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C136/C136M	(2019) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C566	(2013) Standard Test Method for Total Evaporable Moisture Content of Aggregate by Drying
ASTM D979/D979M	(2015) Sampling Bituminous Paving Mixtures
ASTM D2041/D2041M	(2011) Theoretical Maximum Specific

	Gravity and Density of Bituminous Paving Mixtures
ASTM D2172/D2172M	(2017; E 2018) Standard Test Methods for Quantitative Extraction of Asphalt Binder from Asphalt Mixtures
ASTM D2726/D2726M	(2019) Standard Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D3203/D3203M	(2017) Standard Test Method for Percent Air Voids in Compacted Asphalt Mixtures
ASTM D3665	(2012; R 2017) Standard Practice for Random Sampling of Construction Materials
ASTM D3666	(2016) Standard Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D5361/D5361M	(2016) Standard Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing
ASTM D5444	(2015) Mechanical Size Analysis of Extracted Aggregate
ASTM D5821	(2013; R 2017) Standard Test Method for Determining the Percentage of Fractured Particles in Coarse Aggregate
ASTM D6307	(2019) Standard Test Method for Asphalt Content of Asphalt Mixture by Ignition Method
ASTM D6373	(2016) Standard Specification for Performance Graded Asphalt Binder
ASTM D6926	(2020) Standard Practice for Preparation of Asphalt Mixture Specimens Using Marshall Apparatus
ASTM D8239	(2018) Standard Specification for Performance-Graded Asphalt Binder Using the Multiple Stress Creep and Recovery (MSCR) Test

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

Diamond Grinding Plan; G

Mix Design; G

Contractor Quality Control; G

Recycled Content for RAP in Mix; S

SD-06 Test Reports

Aggregates; G

QC Monitoring

SD-07 Certificates

Asphalt Cement Binder; G

Laboratory Accreditation and Validation

1.3 ACCEPTANCE

1.3.1 Acceptability of Work

Acquire the services of an independent commercial laboratory to perform acceptance testing. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. The materials and the pavement itself will be accepted on the basis of production testing. The Government may make check tests from split samples to validate the results of the production testing. Testing performed by the Government does not reduce the required testing of the independent commercial laboratory. Split samples will be taken for Government testing to reduce the variability between the independent commercial laboratory and the Government's test results. When the difference between the independent commercial laboratory and the Government's test results for split samples exceed the acceptable range of two results for multilaboratory precision for the appropriate test method (i.e. ASTM) then at least one of the laboratories is determined to be in error. An evaluation of procedures and equipment in both laboratories will be made to determine the cause(s) for the differences. Develop steps to correct procedures and equipment to bring multilaboratory precision to within acceptable limits.

1.3.2 Acceptance Requirements

Provide all sampling and testing required for acceptance. Surface smoothness and grade determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus smoothness and grade measurements for the entire lot cannot be made.

1.3.3 Pavement Lots

A standard lot for all requirements is equal to one day's production or 2,000 tons, whichever is smaller. Divide each lot into four equal sublots in order to evaluate laboratory air voids and in-place density. When operational conditions cause a lot to be terminated before the specified four sublots have been completed, use the following procedure to adjust

the lot size and number of tests for the lot. Where three sublots have been completed, they constitute a lot. Where one or two sublots have been completed, incorporate them into the next lot and the total number of sublots (i.e. 5 or 6 sublots) is used for acceptance criteria. Include partial lots at the end of asphalt production into the previous lot. Complete and report all theoretical maximum density, laboratory air voids, and in-place density testing within 24 hours after construction of each lot.

1.3.4 Sublot Sampling

Take one mixture sample for each sublot in accordance with ASTM D979/D979M from a random truck or another location for determining theoretical maximum density, laboratory air voids, any additional testing the Government desires, and Contractor Quality Control. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D3665 and employing tables of random numbers or computer programs.

1.3.5 Additional Sampling and Testing

The Government reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be treated as a separate lot.

1.3.6 Theoretical Maximum Density (TMD)

Measure theoretical maximum density one time for each sublot in accordance with ASTM D2041/D2041M for purposes of calculating laboratory air voids and determining in-place density. The average TMD for each lot will be determined as the average TMD of the random sublot samples. When the TMD on both sides of a longitudinal joint is different, the average of these two TMD values will be used as the TMD needed to calculate the percent joint density.

1.3.7 Laboratory Air Voids

Prepare one set of laboratory compacted specimens for each sublot in accordance with ASTM D6926 using the hand-held hammer for the Marshall Method. Provide three test specimens prepared from the same sample for each set of laboratory compacted specimens. Compact the specimens within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Do not reheat samples prior to compaction. Provide insulated containers as necessary to maintain the sample temperature. Measure the bulk density of laboratory compacted specimens in accordance with ASTM D2726/D2726M. Determine laboratory air voids from one set (three laboratory compacted specimens) for each sublot sample in accordance with ASTM D3203/D3203M.

1.3.7.1 Tolerance

Provide laboratory air voids with a mean absolute deviation of 1.00 percent or less from the JMF for each lot. Remove and replace lots that do not meet the laboratory air voids requirement at least 4 inches into the cold (existing) of the longitudinal joint, at no additional cost to the Government. The mean absolute deviation of the laboratory air void contents from the JMF air void content will be evaluated as shown in the example below.

1.3.7.2 Calculating Laboratory Air Voids

Laboratory air void calculations for each lot will use the average theoretical maximum density values obtained for the lot. Determine the average TMD in accordance with paragraph THEORETICAL MAXIMUM DENSITY (TMD). The mean absolute deviation of the laboratory air void contents (one from each subplot) from the JMF air void content will be evaluated as in the following example:

Assume that the laboratory air voids are determined from 4 sublots where one set of laboratory compacted specimens is from a single subplot. The laboratory air voids for the 4 sublots are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0. The mean absolute deviation is then:

$$\text{Mean Absolute Deviation} = (|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|)/4$$

$$\text{Mean Absolute Deviation} = (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45$$

The mean absolute deviation for laboratory air voids is determined to be 0.45. It can be seen that 0.45 is less than 1.00 percent. The lot is acceptable for laboratory air voids.

1.3.8 In-place Density

Obtain one random 4 inch or 6 inch diameter core from the mat and joint of each subplot in accordance with ASTM D5361/D5361M for determining in-place density. Cut samples neatly with a diamond core drill bit. Obtain random cores that are the full thickness of the layer being placed. Select core locations randomly using the procedures contained in ASTM D3665. Locate cores for mat density no closer than 12 inches from a transverse or longitudinal joint including the pavement edge. Center all cores for joint density on the joint. Discard samples that are clearly defective as a result of sampling and take an additional random core. When the random core is less than 1 inch thick, it will not be included in the analysis. In this case, obtain another random core sample. Clean and tack coat dry core holes before filling with asphalt mixture. Fill all core holes with asphalt mixture and compact using a standard Marshall hammer to the density specified. Provide all tools, labor, and materials for cutting samples, cleaning, and filling the cored pavement. Measure in-place density in accordance with ASTM D2726/D2726M using each core obtained from the mat and joint.

1.3.8.1 Tolerance

Provide a minimum in-place mat density of 93.0 percent and a minimum in-place joint density of 90.0 percent for each lot. The average in-place mat and joint densities are expressed as a percentage of the average theoretical maximum density (TMD) for the lot. Determine the average TMD in accordance with paragraph THEORETICAL MAXIMUM DENSITY (TMD). Remove and replace lots that do not meet the in-place mat density requirement at least 4 inches into the cold (existing) of the longitudinal joint, at no additional cost to the Government. Remove and replace the longitudinal joint when the lot does not meet the in-place joint density, at no additional cost to the Government. Use a 10 feet wide paving lane that is centered over the joint.

1.3.9 Surface Smoothness

Use the straightedge method for transverse testing, for longitudinal testing. Smoothness requirements do not apply over crowns or grade breaks. Maintain detailed notes of the testing results and provide a copy to the Government immediately after each day's testing.

1.3.9.1 Smoothness Requirements

1.3.9.1.1 Straightedge Testing

Provide finished surfaces of the pavements with no abrupt change of 1/4 inch or more when checked with an approved 12 foot straightedge. Remove and replace surface lift lots when the surface smoothness exceeds 3/8 inch, at no additional cost to the Government. High spots can be diamond ground as an alternative to remove and replace in order to meet surface smoothness requirements at individual locations.

1.3.9.2 Testing Method

After the final rolling, but not later than 24 hours after placement, test the surface of the pavement in each entire lot in a manner to reveal surface irregularities exceeding the tolerances specified above. If any pavement areas are diamond ground, retest these areas immediately after diamond grinding. The maximum area allowed to be corrected by diamond grinding is 10 percent of the total area of the lot. Check a number of random locations along with any observed suspicious locations primarily at transverse and longitudinal joints with the straightedge.

1.3.9.2.1 Straightedge Testing

Use the straightedge to measure abrupt changes in surface smoothness. Hold the straightedge in contact with the pavement surface and measure the maximum distance between the straightedge and the pavement surface. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

1.3.9.2.2 Bumps ("Must Grind" Areas)

Reduce any bumps ("must grind" areas) which exceed 0.4 inch in height by diamond grinding until they do not exceed 0.3 inch when retested. Taper diamond grinding in all directions to provide smooth transitions to areas not requiring diamond grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas.

1.3.10 Plan Grade

Provide a final wearing surface of pavement conforming to the elevations and cross sections shown and not vary more than 0.05 foot from the plan grade established and approved at site of work. Within 5 working days after completion of a particular lot incorporating the final wearing course, test the final wearing surface of the pavement for conformance with specified plan grade requirements. Match finished surfaces at juncture with other pavements with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in

areas of pavements where closer conformance with planned elevation is required for the proper functioning of drainage and other appurtenant structures involved. For parking lots, the grade will be determined by running lines of levels at intervals of 25 feet or less longitudinally and transversely to determine the elevation of the completed pavement surface.

Diamond grinding can be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted. Maintain detailed notes of the results of the testing and provide a copy to the Government immediately after each day's testing. Remove and replace surface lift lots when individual locations exceed 0.05 foot tolerance, at no additional cost to the Government. High spots can be diamond ground as an alternative to remove and replace in order to meet plan grade requirements at individual locations.

1.3.11 Laboratory Accreditation and Validation

Provide laboratories used to develop the Job Mix Formula (JMF), perform acceptance testing, and Contractor Quality Control testing that meet the requirements of ASTM D3666. Provide laboratories with a masonry saw having a diamond blade for trimming pavement cores and samples. Perform all required test methods by an accredited laboratory. Schedule and provide payment for laboratory inspections. Additional payment or a time extension due to failure to acquire the required laboratory accreditation is not allowed. All testing laboratories performing acceptance testing require USACE validation by the Material Testing Center (MTC) for both parent laboratory and plant testing laboratory. Validation on all laboratories is required to remain current throughout the duration of the paving project. Contact the MTC manager listed at <https://mtc.erdcdren.mil> for costs and scheduling. Submit a certificate of compliance signed by the manager of the laboratory stating that it meets these requirements to the Government prior to the start of construction. At a minimum, include the following certifications:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.

1.4 ENVIRONMENTAL REQUIREMENTS

Do not place the asphalt mixture upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 3 Table 1. The temperature requirements may be waived by the Government, if requested; however, meet all other requirements including compaction.

Table 3. Table 1. Surface Temperature Limitations of Underlying Course	
Mat Thickness, inches	Degrees F
3 or greater	40
Less than 3	45

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Perform the work consisting of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. Provide asphalt pavement designed and constructed in accordance with this section conforming to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Construct each course to the depth, section, or elevation required by the drawings and rolled, finished, and approved before the placement of the next course.

2.1.1 Asphalt Mixing Plant

Provide plants used for the preparation of asphalt mixture conforming to the requirements of AASHTO M 156 with the following changes:

2.1.1.1 Truck Scales

Weigh the asphalt mixture on approved scales, or on certified public scales at no additional expense to the Government. Inspect and seal scales at least annually by an approved calibration laboratory.

2.1.1.2 Inspection of Plant

Provide access to the Government at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. Provide assistance as requested, for the Government to procure any desired samples.

2.1.1.3 Storage bins

The asphalt mixture can be stored in non-insulated storage bins for a period of time not exceeding 3 hours. The asphalt mixture can be stored in insulated storage bins for a period of time not exceeding 8 hours. Provide the mix drawn from bins that meets the same requirements as mix loaded directly into trucks.

2.1.2 Hauling Equipment

Provide trucks used for hauling asphalt mixture that have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, lightly coat the truck beds with a minimum amount of paraffin oil, lime solution, or other approved material. Do not use petroleum based products as a release agent. Provide each truck with a suitable cover to protect the mixture from adverse weather, contamination, and loss of material during hauling. When necessary due to long haul distance and cold weather, provide insulated truck beds with covers (tarps) that are securely fastened.

2.1.3 Asphalt Pavers

Provide mechanical spreading and finishing equipment consisting of a self-powered paver, capable of spreading and finishing the mixture to the specified line, grade, and cross section. Provide paver screed capable of laying a uniform mixture to meet the specified thickness, smoothness, and

grade without physical or temperature segregation, the full width of the material being placed. Provide a paver with a vibrating screed to be used during all placement.

2.1.3.1 Receiving Hopper

Provide paver with a receiving hopper of sufficient capacity to permit a uniform spreading operation and a distribution system to place the mixture uniformly in front of the screed without segregation. Provide a screed that effectively produces a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

2.1.3.2 Automatic Grade Controls

Provide a paver equipped with a control system capable of maintaining the specified screed elevation. One of three methods can be used to control grade: stringline, laser, or computerized elevations along with GPS. For multiple layers it is acceptable to control the grade in the underlying layer and control the grade of the surface layer by applying a constant thickness over the underlying layer which has been placed to the desired grade. Slope control can also be used to control the grade of the surface for roads, but is not acceptable for wide pavements such as parking lots. Provide transverse slope controller capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A ski-type device of not less than 30 ft can be used to provide improved smoothness. Use a shoe on one side of the paver to match an existing paved surface to provide a smooth joint.

2.1.4 Rollers

Provide rollers in good condition and operate at slow speeds to avoid displacement of the asphalt mixture. Provide sufficient number, type, and weight of rollers to compact the mixture to the required density while it is still in a workable condition. Do not use equipment which causes excessive crushing of the aggregate.

2.1.5 Diamond Grinding

Those performing diamond grinding are required to have a minimum of three years experience in diamond grinding. In areas not meeting the specified limits for surface smoothness and plan grade, reduce high areas to attain the required smoothness and grade, except as depth is limited below. Reduce high areas by diamond grinding the asphalt pavement with approved equipment. Perform diamond grinding by sawing with saw blades impregnated with an industrial diamond abrasive. Assemble the saw blades in a cutting head mounted on a machine designed specifically for diamond grinding that produces the required texture and smoothness level without damage to the asphalt pavement or joint faces. Provide diamond grinding equipment with saw blades that are 1/8-inch wide, a minimum of 60 blades per 12 inches of cutting head width, and capable of cutting a path a minimum of 3 feet wide. Diamond grinding equipment that causes raveling, fracturing of aggregate, or disturbance to the underlying material will not be allowed. The maximum area corrected by diamond grinding the surface of the asphalt pavement is 10 percent of the total area of any lot. The maximum depth of diamond grinding is 1/2 inch. Provide diamond grinding machine equipped to flush and vacuum the pavement surface. Dispose of all debris from diamond grinding operations off Government property. Prior to diamond grinding, submit a Diamond Grinding Plan for review and approval. At a minimum, include the daily reports for the deficient areas, the location

and extent of deficiencies, corrective actions, and equipment. Remove and replace all pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified.

Prior to production diamond grinding operations, perform a test section at the approved location, consisting of a minimum of two adjacent passes with a minimum length of 40 feet to allow evaluation of the finish and transition between adjacent passes. Production diamond grinding operations cannot be performed prior to approval.

2.2 AGGREGATES

Notify the Government at least 7 days before sampling aggregates. Provide aggregates in accordance with the current edition of the CDOT Standard Specifications for Road and Bridge Construction; Sections 401.02 - 401.06 and applicable requirements of Subsection 703.05.

2.3 ASPHALT CEMENT BINDER

Provide asphalt cement binder that conforms to ASTM D6373 and ASTM D8239 Performance Grade (PG) 58-28. Provide test data indicating grade certification by the supplier at the time of delivery of each load to the mix plant. Submit copies of these certifications to the Government. The supplier is defined as the last source of any modification to the binder. The Government may sample and test the binder at the mix plant at any time before or during mix production.

2.4 MIX DESIGN

Develop the mix design in accordance with the current edition of the CDOT Standard Specifications for Road and Bridge Construction; Sections 400 and 403.

2.4.1 JMF Requirements

Submit the proposed JMF in writing, for approval, at least 14 days prior to the start of paving operations including, as a minimum:

- a. Percent passing each sieve size.
- b. Percent of asphalt cement.
- c. Percent of each aggregate and mineral filler to be used.
- d. Asphalt performance grade or penetration grade.
- e. Laboratory mixing temperature.
- f. Laboratory compaction temperature.
- g. Temperature-viscosity relationship of the asphalt cement
- h. Graphical plots and summary tabulation of air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2. Include summary tabulation that includes individual specimen data for each specimen tested.
- i. Specific gravity and absorption of each aggregate.

- j. Percent natural sand.
- k. Percent particles with two or more fractured faces (in coarse aggregate).
- l. Fine aggregate angularity.
- m. Percent flat or elongated particles in coarse aggregate.
- n. Tensile Strength Ratio and wet/dry specimen test results.
- o. Antistrip agent (if required).
- p. List of all modifiers.
- q. Percentage and properties (asphalt content, aggregate gradation, and aggregate properties) of RAP in accordance with paragraph RECYCLED ASPHALT PAVEMENT, if RAP is used. Provide product data confirming recycled content for RAP in mix.

2.4.2 Adjustments to JMF

The JMF for each mixture is in effect until a new formula is approved in writing by the Government. Should a change in sources of any materials be made, perform a new mix design and a new JMF approved before the new material is used. 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 and 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 RECYCLED HOT MIX ASPHALT

Provide recycled asphalt mixture consisting of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. Provide RAP of a consistent gradation, asphalt content, and properties. Maintain RAP stockpiles free from contamination including coal-tar sealers. Limit the maximum RAP chunk size to 2 inches when feeding RAP into the plant. The individual aggregates in a RAP chunk are not to exceed the maximum size aggregate of the gradation specified. Design the recycled asphalt mixture using procedures contained in the CDOT M-E Pavement Design Manual. Provide RAP job mix that meets the requirements of paragraph MIX DESIGN. Limit the amount of RAP so the asphalt binder from the RAP does not exceed 30 percent of the total asphalt content.

PART 3 EXECUTION

3.1 CONTRACTOR QUALITY CONTROL

3.1.1 General Quality Control Requirements

Submit the Quality Control Plan. Do not produce hot-mix asphalt until the quality control plan has been approved. In the quality control plan, address all elements which affect the quality of the pavement including, but not limited to:

- a. Mix Design and unique JMF identification code
- b. Aggregate Grading
- c. Quality of Materials
- d. Stockpile Management and procedures to prevent contamination
- e. Proportioning
- f. Mixing and Transportation
- g. Mixture Volumetrics
- h. Moisture Content of Mixtures
- i. Placing and Compaction
- j. Joints
- k. Surface Smoothness
- l. Truck bed release agent

3.1.2 Testing Laboratory

Provide a fully equipped asphalt laboratory located at the plant or job site that is equipped with heating and air conditioning units to maintain a temperature of 75 plus or minus 5 degrees F. Provide laboratory facilities that are kept clean and all equipment maintained in proper working condition. Provide the Government with unrestricted access to inspect the laboratory facility, to witness quality control activities, and to perform any check testing desired. The Government will advise in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, immediately suspend the incorporation of the materials into the work. Incorporation of the materials into the work will not be permitted to resume until the deficiencies are corrected.

3.1.3 Quality Control Testing

Perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. Use the independent commercial laboratory for acceptance testing in paragraph ACCEPTANCE. Use in-house capabilities or the independent commercial laboratory for quality control testing. Required elements of the testing program include, but are not limited to tests for the control of asphalt content, aggregate gradation, aggregate moisture, moisture in the asphalt mixture, temperatures, VMA, and in-place density. Develop a Quality Control Testing Plan as part of the Quality Control Program.

3.1.3.1 Asphalt Content

Determine asphalt content a minimum of twice per lot (a lot is defined in paragraph PAVEMENT LOTS) using the ignition method in accordance with ASTM D6307. Use the extraction method in accordance with ASTM D2172/D2172M if the correction factor for the ignition method in ASTM D6307 is greater

than 1.0. The asphalt content for the lot will be determined by averaging the test results.

3.1.3.2 Aggregate Properties

Determine aggregate gradations a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with ASTM D5444, ASTM C136/C136M, and ASTM C117. Determine the specific gravity of each aggregate size grouping for each 20,000 tons in accordance with ASTM C127 or ASTM C128. Determine fractured faces for gravel sources for each 20,000 tons in accordance with ASTM D5821. Determine the uncompacted void content of natural sand, manufactured sand, and blended aggregate for each 20,000 tons in accordance with AASHTO T 304 Method A.

3.1.3.3 Moisture Content of Aggregate

Determine the moisture content of aggregate used for production a minimum of once per lot in accordance with ASTM C566.

3.1.3.4 Moisture Content of Asphalt Mixture

Determine the moisture content of the asphalt mixture at least once per lot in accordance with AASHTO T 329.

3.1.3.5 Temperatures

Check temperatures at least four times per lot, at necessary locations to determine the temperature at the dryer, the asphalt cement binder in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.1.3.6 VMA

Obtain mixture samples at least four times per lot. Calculate the VMA of each specimen in accordance with AI MS-2 based on ASTM C127 and ASTM C128 bulk specific gravity for the aggregate.

3.1.3.7 In-Place Density

Conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge or other non-destructive testing device can be used to monitor pavement density.

3.1.3.8 Additional Testing

Perform any additional testing deemed necessary to control the process.

3.1.3.9 QC Monitoring

Submit all QC test results to the Government on a daily basis as the tests are performed. The Government reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.1.4 Sampling

When directed by the Government, sample and test any material which appears to not meet specification requirements unless such material is voluntarily removed and replaced or deficiencies corrected. Perform all

sampling in accordance with standard procedures specified.

3.1.5 Control Charts

For process control, establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6 Table 4, as a minimum. Post the control charts as directed by the Government and maintain current at all times. Identify the following on the control charts: the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 Table 4 applicable to the test parameter being plotted, and the test results. Also show target values (JMF) on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, halt production until the problem is solved. When the Suspension Limit is exceeded for individual values or running average values, the Government has the option to require removal and replacement of the material represented by the samples or to leave in place and base acceptance on mixture volumetric properties and in place density. Use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Make decisions concerning mix modifications based on analysis of the results provided in the control charts. In the Quality Control Plan, indicate the appropriate action to be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 6. Table 4. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts				
Parameter to be Plotted	Individual Samples		Running Average of	
	Action Limit	Suspension Limit	Action Limit	Suspension Limit
No. 4 sieve, Cumulative percent passing, deviation for JMF target; plus or minus values	6	8	4	5
No. 30 sieve, Cumulative percent passing, deviation for JMF target; plus or minus values	4	6	3	4
No. 200 sieve, Cumulative percent passing, deviation for JMF target; plus or minus values	1.4	2.0	1.1	1.5
Asphalt content, percent deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3
Stability, pounds (minimum) (NA for Superpave)				
75 Blow JMF	1800	1700	1900	1800
50 Blow JMF	1000	900	1100	1000
Flow, 0.01 inch (NA for Superpave)				
75 Blow JMF	8 min.	7 min.	9 min.	8 min.
	16 max.	17 max.	15 max.	16 max.

Table 6. Table 4. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts				
	Individual Samples		Running Average of	
Parameter to be Plotted	Action Limit	Suspension Limit	Action Limit	Suspension Limit
50 Blow JMF	8 min.	7 min.	9 min.	8 min.
	18 max.	19 max.	17 max.	18 max.
Laboratory Air Voids, percent deviation from JMF target value	No specific action and suspension limits set since this parameter is used for acceptance			
In-place Mat Density, percent of TMD	No specific action and suspension limits set since this parameter is used for acceptance			
In-place Joint Density, percent of TMD	No specific action and suspension limits set since this parameter is used for acceptance			
VMA				
Gradation 1	13.5	13.0	13.3	13.0
Gradation 2	14.5	14.0	14.3	14.0
Gradation 3	15.5	15.0	15.3	15.0

3.2 PREPARATION OF ASPHALT BINDER MATERIAL

Heat the asphalt cement material while avoiding local overheating. Provide a continuous supply of the asphalt material to the mixer at a uniform temperature. Maintain the temperature of the asphalt delivered to the mixer to provide a suitable viscosity for adequate coating of the aggregate particles. For hot-mix, do not heat unmodified asphalt to a temperature exceeding 325 degrees F when added to the aggregate. Do not heat modified asphalt to a temperature exceeding 350 degrees F when added to the aggregate.

3.3 PREPARATION OF MINERAL AGGREGATE

Heat and dry the aggregate prior to mixing. Provide a rate of heating and a maximum temperature that does not damage the aggregates. Do not heat the aggregate to a temperature exceeding 350 degrees F when the asphalt binder is added. Maintain the temperature no lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.4 PREPARATION OF ASPHALT MIXTURE

Weigh or meter the aggregates and the asphalt cement and introduce into the mixer the amount specified by the JMF. Mix the combined materials until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. The moisture content of all asphalt mixture upon discharge from the plant is not to exceed 0.5 percent by total weight of mixture as measured by AASHTO T 329.

3.5 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the asphalt mixture, clean the underlying course of dust and debris. Apply a prime coat in accordance with the current edition of the CDOT Standard Specifications for Road and Bridge Construction; Section 407.

3.6 TRANSPORTING AND PLACING

3.6.1 Transporting

Transport asphalt mixture from the mixing plant to the site in clean, tight vehicles. Schedule deliveries so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Provide adequate artificial lighting for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 140 degrees F.

3.6.2 Placing

Place the mix in lifts of adequate thickness and compact at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, place the mixture to the full width by an asphalt paver; strike off in a uniform layer of such depth that, when the work is completed, the required thickness is obtained and the surface conforms to the grade and contour indicated. Do not broadcast waste mixture onto the mat or recycle into the paver hopper. Collect waste mixture and dispose off site. Regulate the speed of the paver to eliminate pulling and tearing of the asphalt mat. Begin placement of the mixture along the centerline of a crowned section or on the high side of areas with a one-way slope. Place the mixture in consecutive adjacent strips having a minimum width of 10 feet. Offset the longitudinal joint in one course from the longitudinal joint in the course immediately below by at least 1 foot; however, locate the joint in the surface course at the centerline of the pavement. Offset transverse joints in one course by at least 10 feet from transverse joints in the previous course. Offset transverse joints in adjacent lanes a minimum of 10 feet. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture can be spread and luted by hand tools.

3.7 COMPACTION OF MIXTURE

3.7.1 General

- a. After placing, thoroughly and uniformly compact the mixture by rolling. Compact the surface as soon as possible without causing displacement, cracking, or shoving. Determine the sequence of rolling operations and the type of rollers used with the exception that application of more than three passes with a vibratory roller in the vibrating mode is prohibited. Maintain the speed of the roller, at all times, sufficiently slow to avoid displacement of the asphalt mixture and to be effective in compaction. Correct at once any displacement occurring as a result of reversing the direction of the roller, or from any other cause.
- b. Furnish sufficient rollers to handle the output of the plant. Continue rolling until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, keep the wheels properly moistened, but excessive water is not permitted. In areas not accessible to the roller, thoroughly compact the mixture with hand tampers or small compactors. Remove the full depth of any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective. Replace with fresh asphalt mixture and immediately compact to conform to the surrounding

area. Perform this work at no expense to the Government. Skin patching is not allowed.

3.7.2 Segregation

The Government can sample and test any material that looks deficient. When the in-place material appears to be segregated, the Government has the option to sample the material and have it tested and compared to the in-place density requirements in Table 2 paragraph ACCEPTANCE. If the material fails to meet these specification requirements, remove and replace the extent of the segregated material the full depth of the layer of asphalt mixture at no additional cost to the Government. When segregation occurs in the mat, take appropriate action to correct the process so that additional segregation does not occur.

3.8 JOINTS

Construct joints to ensure a continuous bond between the courses and to obtain the required density. Provide all joints with the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.8.1 Transverse Joints

Do not pass the roller over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, construct by means of placing a bulkhead or by tapering the course. Utilize a dry saw cut on the transverse joint full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. Remove the cutback material from the project. In both methods, provide a light tack coat of asphalt material to all contact surfaces before placing any fresh mixture against the joint.

3.8.2 Longitudinal Joints

Provide a joint that meets density and smoothness requirements for joints and has uniform texture. Cut back longitudinal joints which are irregular, damaged, uncompacted, cold (less than 175 degrees F at the time of placing adjacent lanes), or otherwise defective, a maximum of 3 inches from the top of the course with a cutting wheel to expose a clean, sound, near vertical surface for the full depth of the course. Remove all cutback material from the project. Provide a light tack coat of asphalt material to all contact surfaces prior to placing any fresh mixture against the joint.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 16 19

CONCRETE CURBS, GUTTERS AND SIDEWALKS

05/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 EQUIPMENT, TOOLS, AND MACHINES
 - 1.3.1 General Requirements
 - 1.3.2 Slip Form Equipment
- 1.4 ENVIRONMENTAL REQUIREMENTS
 - 1.4.1 Placing During Cold Weather
 - 1.4.2 Placing During Warm Weather

PART 2 PRODUCTS

- 2.1 CONCRETE
 - 2.1.1 Air Content
 - 2.1.2 Slump
 - 2.1.3 Reinforcement Steel
- 2.2 CONCRETE CURING MATERIALS
 - 2.2.1 Impervious Sheet Materials
 - 2.2.2 Burlap
 - 2.2.3 White Pigmented Membrane-Forming Curing Compound
- 2.3 CONCRETE PROTECTION MATERIALS
- 2.4 JOINT FILLER STRIPS
 - 2.4.1 Contraction Joint Filler for Curb and Gutter
 - 2.4.2 Expansion Joint Filler, Premolded
- 2.5 JOINT SEALANTS
- 2.6 FORM WORK
 - 2.6.1 Wood Forms
 - 2.6.2 Steel Forms
 - 2.6.3 Sidewalk Forms
 - 2.6.4 Curb and Gutter Forms
- 2.7 Detectable Warning System

PART 3 EXECUTION

- 3.1 SUBGRADE PREPARATION
 - 3.1.1 Sidewalk Subgrade
 - 3.1.2 Curb and Gutter Subgrade
 - 3.1.3 Maintenance of Subgrade
- 3.2 FORM SETTING
 - 3.2.1 Sidewalks
 - 3.2.2 Curbs and Gutters
- 3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING
 - 3.3.1 Formed Sidewalks
 - 3.3.2 Concrete Finishing
 - 3.3.3 Edge and Joint Finishing

- 3.3.4 Surface and Thickness Tolerances
- 3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING
 - 3.4.1 Formed Curb and Gutter
 - 3.4.2 Curb and Gutter Finishing
 - 3.4.3 Concrete Finishing
 - 3.4.4 Joint Finishing
 - 3.4.5 Surface and Thickness Tolerances
- 3.5 SIDEWALK JOINTS
 - 3.5.1 Sidewalk Contraction Joints
 - 3.5.2 Sidewalk Expansion Joints
 - 3.5.3 Reinforcement Steel Placement
- 3.6 CURB AND GUTTER JOINTS
 - 3.6.1 Contraction Joints
 - 3.6.2 Expansion Joints
- 3.7 CURING AND PROTECTION
 - 3.7.1 General Requirements
 - 3.7.1.1 Mat Method
 - 3.7.1.2 Impervious Sheeting Method
 - 3.7.1.3 Membrane Curing Method
 - 3.7.2 Backfilling
 - 3.7.3 Protection
 - 3.7.4 Protective Coating
 - 3.7.4.1 Application
 - 3.7.4.2 Precautions
- 3.8 FIELD QUALITY CONTROL
 - 3.8.1 General Requirements
 - 3.8.2 Concrete Testing
 - 3.8.2.1 Strength Testing
 - 3.8.2.2 Air Content
 - 3.8.2.3 Slump Test
 - 3.8.3 Thickness Evaluation
 - 3.8.4 Surface Evaluation
- 3.9 SURFACE DEFICIENCIES AND CORRECTIONS
 - 3.9.1 Thickness Deficiency
 - 3.9.2 High Areas
 - 3.9.3 Appearance
- 3.10 DETECTABLE WARNING SYSTEM

-- End of Section Table of Contents --

SECTION 32 16 19

CONCRETE CURBS, GUTTERS AND SIDEWALKS
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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M 182 (2005; R 2017) Standard Specification for
Burlap Cloth Made from Jute or Kenaf and
Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M (2020) Standard Specification for Deformed
and Plain Carbon-Steel Bars for Concrete
Reinforcement

ASTM A1064/A1064M (2017) Standard Specification for
Carbon-Steel Wire and Welded Wire
Reinforcement, Plain and Deformed, for
Concrete

ASTM C31/C31M (2021a) Standard Practice for Making and
Curing Concrete Test Specimens in the Field

ASTM C143/C143M (2020) Standard Test Method for Slump of
Hydraulic-Cement Concrete

ASTM C171 (2020) Standard Specification for Sheet
Materials for Curing Concrete

ASTM C172/C172M (2017) Standard Practice for Sampling
Freshly Mixed Concrete

ASTM C173/C173M (2016) Standard Test Method for Air
Content of Freshly Mixed Concrete by the
Volumetric Method

ASTM C231/C231M (2017a) Standard Test Method for Air
Content of Freshly Mixed Concrete by the
Pressure Method

ASTM C309 (2019) Standard Specification for Liquid
Membrane-Forming Compounds for Curing
Concrete

ASTM C920 (2018) Standard Specification for

Elastomeric Joint Sealants

ASTM D1751	(2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D5893/D5893M	(2016) Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 COMM	(2017) Standard And Commentary Accessible and Usable Buildings and 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 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

Concrete

SD-06 Test Reports

Field Quality Control

1.3 EQUIPMENT, TOOLS, AND MACHINES

1.3.1 General Requirements

Plant, equipment, machines, and tools used in the work will be subject to approval and must be maintained in a satisfactory working condition at all times. Use equipment capable of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Discontinue using equipment that produces unsatisfactory results. Allow the Contracting Officer access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.3.2 Slip Form Equipment

Slip form paver or curb forming machines, will be approved based on trial use on the job and must be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection must be approved in writing. Approval will be contingent upon full conformance with the following provisions. Prepare and protect the underlying material so that it is entirely free of frost when the concrete is deposited. Heat mixing water as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating must be approved. Use only aggregates that are free of ice, snow, and frozen lumps before entering the mixer. Provide covering or other means as needed to maintain the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.4.2 Placing During Warm Weather

The temperature of the concrete as placed must not exceed 85 degrees F except where an approved retarder is used. Cool the mixing water and aggregates as necessary to maintain a satisfactory placing temperature. The placing temperature must not exceed 95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of Section 03 30 00 CAST-IN-PLACE CONCRETE except as otherwise specified. Concrete must have a minimum compressive strength of 3500 psi at 28 days. Size of aggregate must not exceed 1-1/2 inches. Submit copies of certified delivery tickets for all concrete used in the construction.

2.1.1 Air Content

Use concrete mixtures that have an air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

Use concrete with a slump of 3 inches plus or minus 1 inch for hand placed concrete or 1 inch plus or minus 1/2 inch for slipformed concrete as determined in accordance with ASTM C143/C143M.

2.1.3 Reinforcement Steel

Use reinforcement bars conforming to ASTM A615/A615M. Use wire mesh reinforcement conforming to ASTM A1064/A1064M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Use impervious sheet materials conforming to ASTM C171, type optional, except that polyethylene film, if used, must be white opaque.

2.2.2 Burlap

Use burlap conforming to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

Use white pigmented membrane-forming curing compound conforming to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Use concrete protection materials consisting of a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Use hard-pressed fiberboard contraction joint filler for curb and gutter.

2.4.2 Expansion Joint Filler, Premolded

Unless otherwise indicated, use 1/2 inch thick premolded expansion joint filler conforming to ASTM D1751 or ASTM D1752.

2.5 JOINT SEALANTS

Use cold-applied joint sealant conforming to ASTM C920 or ASTM D5893/D5893M.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Use wood or steel forms that are straight and of sufficient strength to resist springing during depositing and consolidating concrete.

2.6.1 Wood Forms

Use forms that are surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Use forms with a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness.

2.6.2 Steel Forms

Use channel-formed sections with a flat top surface and welded braces at each end and at not less than two intermediate points. Use forms with

interlocking and self-aligning ends. Provide flexible forms for radius forming, corner forms, form spreaders, and fillers as needed. Use forms with a nominal length of 10 feet and that have a minimum of 3 welded stake pockets per form. Use stake pins consisting of solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.3 Sidewalk Forms

Use sidewalk forms that are of a height equal to the full depth of the finished sidewalk.

2.6.4 Curb and Gutter Forms

Use curb and gutter outside forms that have a height equal to the full depth of the curb or gutter. Use rigid forms for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

2.7 Detectable Warning System

Detectable Warning Systems shown on the Contract plans are to meet requirements of ICC A117.1 COMM - Section 705.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

Construct subgrade to the specified grade and cross section prior to concrete placement.

3.1.1 Sidewalk Subgrade

Place and compact the subgrade in accordance with Section 31 00 00 EARTHWORK. Test the subgrade for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

Place and compact the subgrade in accordance with Section 31 00 00 EARTHWORK. Test the subgrade for grade and cross section by means of a template extending the full width of the curb and gutter. Use subgrade materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade must be in a moist condition when concrete is placed. Prepare and protect subgrade so that it is free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms. Remove forms in a manner that will not injure the concrete. Do not use bars or heavy tools against the concrete when removing the forms. Promptly and satisfactorily repair concrete found to be defective after form removal. Clean forms and coat with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment must be checked with a 10 foot straightedge. Sidewalks must have a transverse slope as indicated and shall not exceed 1.8 percent. Do not remove side forms less than 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

Remove forms used along the front of the curb not less than 2 hours nor more than 6 hours after the concrete has been placed. Do not remove forms used along the back of curb until the face and top of the curb have been finished, as specified for concrete finishing. Do not remove gutter forms while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks must be of the thickness indicated. Use a strike-off guided by side forms after concrete has been placed in the forms to bring the surface to proper section to be compacted. Consolidate concrete by tamping and spading or with an approved vibrator. Finish the surface to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

Finish all slab edges, including those at formed joints, with an edger having a radius of 1/8 inch. Edge transverse joints before brooming. Eliminate the flat surface left by the surface face of the edger with brooming. Clean and solidly fill corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing with a properly proportioned mortar mixture and then finish.

3.3.4 Surface and Thickness Tolerances

Finished surfaces must not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Place concrete to the required section in a single lift. Consolidate concrete using approved mechanical vibrators. Curve shaped gutters must be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated surfaces with a fine-hair brush using longitudinal strokes. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in the same manner as the gutter and curb top. Finish the top surface of gutter and entrance to grade with a wood float.

3.4.4 Joint Finishing

Finish curb edges at formed joints as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces must not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Construct sidewalk joints to divide the surface into rectangular areas. Space transverse contraction joints at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and continuous across the slab. Construct longitudinal contraction joints along the centerline of all sidewalks 10 feet or more in width. Construct transverse expansion joints at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, install transverse expansion joints as indicated. Form expansion joints around structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

Form contraction joints in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness. Unless otherwise approved or indicated, either use a jointer to cut the groove or saw a groove in the hardened concrete with a power-driven saw. Construct sawed joints by sawing a groove in the concrete with a 1/8 inch blade. Provide an ample supply of saw blades on the jobsite before concrete placement is started. Provide at least one standby sawing unit in good working order at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Form expansion joints using 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1752 or building paper. Hold joint filler in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, round joint edges using an edging tool having a radius of 1/8 inch. Remove any concrete over the joint filler. At the end of the curing period, clean the top of expansion joints and fill with cold-applied joint sealant. Use joint sealant that is gray or stone in color. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Apply joint sealing material only when the concrete at the joint is surface dry and atmospheric and concrete temperatures are above 50 degrees F. Immediately remove any excess material on exposed surfaces of the concrete and clean the concrete surfaces.

3.5.3 Reinforcement Steel Placement

Accurately and securely fasten reinforcement steel in place with suitable supports and ties before the concrete is placed.

3.6 CURB AND GUTTER JOINTS

Construct curb and gutter joints at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Construct contraction joints directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

- a. Construct contraction joints (except for slip forming) by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Remove separators as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.
- b. When slip forming is used, cut the contraction joints in the top portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. Cut the contraction joint to a depth of at least one-fourth of the gutter/curb depth using a 1/8 inch saw blade.

3.6.2 Expansion Joints

Form expansion joints by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Construct expansion joints in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement using the same type and thickness of joints as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, provide expansion joints at least 1/2 inch in width at intervals not less than 30 feet nor greater than 120 feet. Seal expansion joints immediately following curing of the concrete or as soon thereafter as weather conditions permit. Seal expansion joints and the top 1 inch depth of curb and gutter contraction-joints with joint sealant. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Concrete at the joint must be surface dry and atmospheric and concrete temperatures must be above 50 degrees F at the time of application of joint sealing material. Immediately remove excess material on exposed surfaces of the concrete and clean concrete surfaces.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete must be on hand and ready for use before actual concrete placement begins. Protect concrete as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

Cover the entire exposed surface with two or more layers of burlap. Overlap mats at least 6 inches. Thoroughly wet the mat with water prior to placing on concrete surface and keep the mat continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

Wet the entire exposed surface with a fine spray of water and then cover with impervious sheeting material. Lay sheets directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. Use sheeting that is not less than 18-inches wider than the concrete surface to be cured. Secure sheeting using heavy wood planks or a bank of moist earth placed along edges and laps in the sheets. Satisfactorily repair or replace sheets that are torn or otherwise damaged during curing. Sheeting must remain on the concrete surface to be cured for not less than 7 days.

3.7.1.3 Membrane Curing Method

Apply a uniform coating of white-pigmented membrane-curing compound to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Coat formed surfaces immediately after the forms are removed and in no case longer than 1 hour

after the removal of forms. Do not allow concrete surface to dry before application of the membrane. If drying has occurred, moisten the surface of the concrete with a fine spray of water and apply the curing compound as soon as the free water disappears. Apply curing compound in two coats by hand-operated pressure sprayers at a coverage of approximately 200 square feet/gallon for the total of both coats. Apply the second coat in a direction approximately at right angles to the direction of application of the first coat. The compound must form a uniform, continuous, coherent film that will not check, crack, or peel and must be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, apply an additional coat to the affected areas within 30 minutes. Respray concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied by the method and at the coverage specified above. Respray areas where the curing compound is damaged by subsequent construction operations within the curing period. Take precautions necessary to ensure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. Tightly seal the top of the joint opening and the joint groove at exposed edges before the concrete in the region of the joint is resprayed with curing compound. Use a method used for sealing the joint groove that prevents loss of moisture from the joint during the entire specified curing period. Provide approved standby facilities for curing concrete pavement at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Adequately protect concrete surfaces to which membrane-curing compounds have been applied during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from other possible damage to the continuity of the membrane.

3.7.2 Backfilling

After curing, remove debris and backfill, grade, and compact the area adjoining the concrete to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Protect completed concrete from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Remove and reconstruct concrete that is damaged for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Dispose of removed material as directed.

3.7.4 Protective Coating

Apply a protective coating of linseed oil mixture to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Moist cure concrete to receive a protective coating.

3.7.4.1 Application

Complete curing and backfilling operation prior to applying two coats of protective coating. Concrete must be surface dry and clean before each application. Spray apply at a rate of not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each

application for commercially prepared mixture must be in accordance with the manufacturer's instructions. Protect coated surfaces from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Do not heat protective coating by direct application of flame or electrical heaters and protect the coating from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Do not apply material at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and additional tests to ensure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Take concrete samples in accordance with ASTM C172/C172M not less than once a day nor less than once for every 250 cubic yards of concrete placed. Mold cylinders in accordance with ASTM C31/C31M for strength testing by an approved laboratory. Each strength test result must be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. Use ASTM C231/C231M with concretes and mortars made with relatively dense natural aggregates. Make two tests for air content on randomly selected batches of each class of concrete placed during each shift. Make additional tests when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. Notify the placing foreman if results are out of tolerance. The placing foreman must take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Perform two slump tests on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Perform additional tests when excessive variation in the workability of the concrete is noted or when excessive

crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

Determine the anticipated thickness of the concrete prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, construct the subgrade true to grade prior to concrete placement. The thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

Provide finished surfaces for each category of the completed work that are uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, reduce high areas either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete must not exceed 5 percent of the area of any integral slab, and the depth of grinding must not exceed 1/4 inch. Remove and replace pavement areas requiring grade or surface smoothness corrections in excess of the limits specified.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Contracting Officer and deficiencies in appearance will be identified. Remove and replace areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work.

3.10 DETECTABLE WARNING SYSTEM

Install Detectable Warning Systems required by Contract plans in accordance with ICC A117.1 COMM, Section 705, and by manufacturers' installation instructions.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 17 23

PAVEMENT MARKINGS

08/16, CHG 5: 11/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY ASSURANCE
 - 1.3.1 Regulatory Requirements
 - 1.3.2 Qualifications
- 1.4 DELIVERY AND STORAGE
- 1.5 PROJECT/SITE CONDITIONS
 - 1.5.1 Environmental Requirements
 - 1.5.1.1 Weather Limitations for Application
 - 1.5.1.2 Weather Limitations for Removal of Pavement Markings on Roads and Automotive Parking Areas
 - 1.5.2 Traffic Controls

PART 2 PRODUCTS

- 2.1 EQUIPMENT
 - 2.1.1 Surface Preparation and Paint Removal
 - 2.1.1.1 Surface Preparation Equipment for Roads and Automotive Parking Areas
 - 2.1.1.1.1 Sandblasting Equipment
 - 2.1.1.1.2 Waterblasting Equipment
 - 2.1.1.1.3 Grinding or Scarifying Equipment
 - 2.1.1.1.4 Chemical Removal Equipment
 - 2.1.2 Application Equipment
 - 2.1.2.1 Paint Application Equipment
 - 2.1.2.1.1 Hand-Operated, Push-Type Machines
 - 2.1.2.2 Thermoplastic Application Equipment
 - 2.1.2.2.1 Thermoplastic Material
 - 2.1.2.2.2 Application Equipment
 - 2.1.2.2.3 Portable Application Equipment
 - 2.1.2.3 Preformed Tape Application Equipment
- 2.2 MATERIALS
 - 2.2.1 Waterborne Paint
 - 2.2.2 Preformed Tape
 - 2.2.3 Raised Pavement Markers Primers and Adhesives

PART 3 EXECUTION

- 3.1 EXAMINATION
 - 3.1.1 Testing for Moisture
 - 3.1.2 Surface Preparation Demonstration
 - 3.1.3 Test Stripe Demonstration
 - 3.1.4 Application Rate Demonstration
 - 3.1.5 Level of Performance Demonstration

- 3.2 EXTERIOR SURFACE PREPARATION
 - 3.2.1 Early Painting of Rigid Pavements
 - 3.2.2 Early Painting of Asphalt Pavements
- 3.3 APPLICATION
 - 3.3.1 Paint
 - 3.3.1.1 Waterborne Paint
 - 3.3.1.1.1 Roads and Parking Lots
 - 3.3.2 Thermoplastic Compound
 - 3.3.2.1 Primer
 - 3.3.3 Preformed Tape
 - 3.3.4 Cleanup and Waste Disposal
- 3.4 FIELD QUALITY CONTROL
 - 3.4.1 Sampling and Testing
 - 3.4.2 Material Inspection
 - 3.4.3 Dimensional Tolerances
 - 3.4.4 Bond Failure Verification

-- End of Section Table of Contents --

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 D4383 (2012) Standard Specification for
Plowable, Raised Retroreflective Pavement
Markers

ASTM D4505 (2012; R 2017) Standard Specification for
Preformed Retroreflective Pavement Marking
Tape for Extended Service Life

ASTM D6628 (2003; R 2015) Standard Specification for
Color of Pavement Marking Materials

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-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; G

Application Equipment List; G

Exterior Surface Preparation

Safety Data Sheets; G

Waterborne Paint; G

Thermoplastic compound; G

SD-06 Test Reports

Waterborne Paint; G

Thermoplastic Compound; G

Test Reports

SD-07 Certificates

Qualifications; G

Waterborne Paint

Volatile Organic Compound, (VOC); G

Thermoplastic Compound

SD-08 Manufacturer's Instructions

Waterborne Paint; G

Thermoplastic Compound; G

1.3 QUALITY ASSURANCE

1.3.1 Regulatory Requirements

Submit certificate stating that the proposed pavement marking paint meets the Volatile Organic Compound, (VOC) regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located. Submit Safety Data Sheets for each product.

1.3.2 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of applicable chemicals. The documentation should include experience on five projects of similar size and scope with references for all personnel.

1.4 DELIVERY AND STORAGE

Deliver paint materials, thermoplastic compound materials, and reflective media in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacture,

manufacturer's directions, and name of manufacturer.

Provide storage facilities at the job site for maintaining materials at temperatures recommended by the manufacturer. Make available paint stored at the project site or segregated at the source for sampling not less than 30 days prior to date of required approval for use to allow sufficient time for testing. Notify the Contracting Officer when paint is available for sampling.

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.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Surface Preparation and Paint Removal

2.1.1.1 Surface Preparation Equipment for Roads and Automotive Parking Areas

Submit a surface preparation equipment list by serial number, type, model, and manufacturer. Include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation. Mobile equipment must allow for removal of markings without damaging the pavement surface or joint sealant. Maintain machines, tools, and equipment used in the performance of the work in satisfactory operating condition.

2.1.1.1.1 Sandblasting Equipment

Use mobile sandblasting equipment capable of producing a pressurized stream of sand and air that effectively removes paint from the surface without filling voids with debris in asphalt or tar pavements or removing joint sealants in Portland cement concrete pavements. Include with the equipment and air compressor, hoses, and nozzles of adequate size and capacity for removing paint. Equip the compressor with traps and coalescing filters that maintain the compressed air free of oil and water.

2.1.1.1.2 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.

2.1.1.1.3 Grinding or Scarifying Equipment

Use equipment capable of removing surface contaminants, paint build-up, or extraneous markings from the pavement surface without leaving any residue. Clean the surface by hydro blast to remove surface contaminants and ash after a weed torch is used to remove paint.

2.1.1.1.4 Chemical Removal Equipment

Use chemical equipment capable of applying and removing chemicals and paint from the pavement surface, leaving only non-toxic biodegradable residue without scarring or other damage to the pavement or joints and joint seals.

2.1.2 Application Equipment

Submit application equipment list appropriate for the material(s) to be used. Include manufacturer's descriptive data and certification for the planned use that indicates area of coverage per pass, pressure adjustment range, tank and flow capacities, and all safety precautions required for operating and maintaining the equipment. Provide and maintain machines, tools, and equipment used in the performance of the work in satisfactory operating condition, or remove them from the work site. Provide mobile and maneuverable application equipment to the extent that straight lines can be followed and normal curves can be made in a true arc.

2.1.2.1 Paint Application Equipment

2.1.2.1.1 Hand-Operated, Push-Type Machines

Provide hand-operated push-type applicator machine of a type commonly used for application of water based paint or two-component, chemically curing paint, thermoplastic, or preformed tape, to pavement surfaces for small marking projects, such as legends and cross-walks, automotive parking areas, or surface painted signs. Provide applicator machine equipped with the necessary tanks and spraying nozzles capable of applying paint uniformly at coverage specified. Hand operated spray guns may be used in areas where push-type machines cannot be used.

2.1.2.2 Thermoplastic Application Equipment

2.1.2.2.1 Thermoplastic Material

Apply thermoplastic material with equipment that is capable of providing continuous uniformity in the dimensions and reflectorization of the marking.

2.1.2.2.2 Application Equipment

- a. Provide application equipment capable of continuous mixing and agitation of the material, with conveying parts which prevent accumulation and clogging between the main material reservoir and the extrusion shoe or spray gun. All parts of the equipment which come into contact with the material must be easily accessible and exposed for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns must maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.
- b. Provide application equipment constructed to ensure continuous uniformity in the dimensions of the stripe. Provide an applicator with a means for cleanly cutting off stripe ends squarely and providing a method of applying "skiplines." Provide equipment capable of applying varying widths of traffic markings.
- c. Provide mobile and maneuverable application equipment allowing straight lines to be followed and normal curves to be made in a true arc. Provide equipment used for the placement of thermoplastic pavement markings of two general types: mobile applicator and portable applicator.
- d. Equip the applicator with a pressurized or drop-on type bead dispenser capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser must operate automatically to begin flow prior to the flow of binder to assure that the strip is fully reflectorized.

2.1.2.2.3 Portable Application Equipment

Provide portable hand-operated equipment, specifically designed for placing special markings such as crosswalks, stop bars, legends, arrows, and short lengths of lane, edge and centerlines; and capable of applying thermoplastic pavement markings by the extrusion method. Equip the portable applicator with all the necessary components, including a

materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, capable of holding the molten thermoplastic at the temperature recommended by the manufacturer, and of extruding a line of 3 to 12 inches in width, and in thickness of not less than 0.120 inch nor more than 0.190 inch and of generally uniform cross section.

2.1.2.3 Preformed Tape Application Equipment

Provide and use mechanical application equipment for the placement of preformed marking tape which is a mobile pavement marking machine specifically designed for use in applying pressure-sensitive pavement marking tape of varying widths. Equip the applicator with rollers, or other suitable compaction device to provide initial adhesion of the material with the pavement surface. Use additional tools and devices as needed to properly seat the applied material as recommended by the manufacturer.

2.2 MATERIALS

Use waterborne paint for roads. Use non-reflectorized waterborne paint for automotive parking areas. The maximum allowable VOC content of pavement markings is 150 grams per liter. Color of markings are indicated on the drawings and must conform to ASTM D6628 for roads and automotive parking areas and SAE AMS-STD-595A for airfields. Provide materials conforming to the requirements specified herein.

2.2.1 Waterborne Paint

FS TT-P-1952, Type I.

2.2.2 Preformed Tape

Provide adherent reflectorized strip preformed tape in accordance with ASTM D4505 Retroreflectivity Level II, Class 1, 2 or 3, Skid Resistance Level B.

2.2.3 Raised Pavement Markers Primers and Adhesives

Use either metallic or nonmetallic markers of the button or prismatic reflector type. Provide permanent color markers as specified for pavement marking, which retain the color and brightness under the action of traffic. Provide button markers with a diameter of not less than 4 inches, spaced not more than 40 feet apart on solid longitudinal lines. Provide button markers with rounded surfaces presenting a smooth contour to traffic and not projecting more than 3/4 inch above level of pavement. Provide plowable pavement markers and adhesive epoxy conforming to ASTM D4383.

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.

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 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.

3.2.1 Early Painting of Rigid Pavements

Pretreat rigid pavements that require early painting with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride. Apply the solution to the areas to be marked.

3.2.2 Early Painting of Asphalt Pavements

For asphalt pavement systems requiring painting application at less than 30 days, apply the paint and beads at half the normal application rate, followed by a second application at the normal rate after 30 days.

3.3 APPLICATION

Apply pavement markings to dry pavements only.

3.3.1 Paint

Apply paint with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the markings, painting operations must cease until the cause of the slow drying is determined and corrected.

3.3.1.1 Waterborne Paint

3.3.1.1.1 Roads and Parking Lots

Apply paint at a rate of 105 plus or minus 5 square feet per gallon.

3.3.2 Thermoplastic Compound

Place thermoplastic pavement markings, free from dirt or tint, upon dry pavement. The temperature must be a minimum of 40 degrees F and rising at the time of installation. Apply all centerline, skipline, edgeline, and other longitudinal type markings with a mobile applicator. Place all special markings, crosswalks, stop bars, legends, arrows, and similar patterns with a portable applicator, using the extrusion method.

3.3.2.1 Primer

After surface preparation has been completed, prime the asphalt or concrete pavement surface with spray equipment. Allow primer materials to "set-up" prior to applying the thermoplastic composition. Allow the asphalt concrete primer to dry to a tack-free condition, usually occurring in less than 10 minutes. Apply asphalt concrete primer to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch (265 to 400 square feet per gallon).

After the primer has "set-up", apply the thermoplastic at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Apply all extruded thermoplastic markings at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch. Apply all sprayed thermoplastic markings at the specified width and the thickness designated in the contract plans. If the plans do not

specify a thickness, apply centerline markings at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch, plus or minus 0.005 inch.

3.3.3 Preformed Tape

The pavement surface and ambient air temperature must be a minimum of 60 degrees F and rising. Place the preformed markings in accordance with the manufacturer's written instructions.

3.3.4 Cleanup and Waste Disposal

Keep the worksite clean and free of debris and waste from the removal and application operations. Dispose of debris at approved sites.

3.4 FIELD QUALITY CONTROL

3.4.1 Sampling and Testing

As soon as the paint and thermoplastic materials are available for sampling, obtain by random selection from the sealed containers, two quart samples of each batch in the presence of the Contracting Officer. Accomplish adequate mixing prior to sampling to ensure a uniform, representative sample. A batch is defined as that quantity of material processed by the manufacturer at one time and identified by number on the label. Clearly identify samples by designated name, specification number, batch number, project contract number, intended use, and quantity involved.

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.

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.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 92 19

SEEDING

08/17

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Stand of Turf
- 1.3 RELATED REQUIREMENTS
- 1.4 SUBMITTALS
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - 1.5.1 Delivery
 - 1.5.1.1 Seed Protection
 - 1.5.1.2 Fertilizer and Lime Delivery
 - 1.5.2 Storage
 - 1.5.2.1 Seed, Fertilizer and Lime Storage
 - 1.5.2.2 Topsoil
 - 1.5.2.3 Handling
- 1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS
 - 1.6.1 Restrictions
- 1.7 TIME LIMITATIONS
 - 1.7.1 Seed

PART 2 PRODUCTS

- 2.1 SEED
 - 2.1.1 Classification
 - 2.1.2 Planting Dates
 - 2.1.3 Seed Purity
 - 2.1.4 Seed Mixture by Weight
- 2.2 TOPSOIL
 - 2.2.1 On-Site Topsoil
 - 2.2.2 Composition
- 2.3 SOIL CONDITIONERS
- 2.4 FERTILIZER
- 2.5 MULCH
 - 2.5.1 Straw
 - 2.5.2 Hay
- 2.6 WATER

PART 3 EXECUTION

- 3.1 PREPARATION
 - 3.1.1 EXTENT OF WORK
 - 3.1.1.1 Topsoil
 - 3.1.1.2 Soil Conditioner Application Rates
 - 3.1.1.3 Fertilizer Application Rates
- 3.2 SEEDING
 - 3.2.1 Seed Application Seasons and Conditions

- 3.2.2 Seed Application Method
 - 3.2.2.1 Broadcast and Drop Seeding
- 3.2.3 Mulching
 - 3.2.3.1 Hay or Straw Mulch
- 3.2.4 Rolling
- 3.2.5 Watering
- 3.3 PROTECTION OF TURF AREAS

-- End of Section Table of Contents --

SECTION 32 92 19

SEEDING
08/17

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM 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, Section 32 93 00 EXTERIOR PLANTS, and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

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

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer and Lime Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 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.

2.1.2 Planting Dates

Planting dates are April 1 to June 1 and August 15 to October 1.

2.1.3 Seed Purity

Botanical Name	Common Name	Mix Rate
Pascopyrum smithii	Western Wheatgrass	6.0 PLS#
Buchloe dactyloides	Buffalograss	6.0 PLS#
Lolium perenne	Perennial Ryegrass	3.0 PLS#
Schizachyrium scoparium	Little Bluestem	2.0 PLS#
Bouteloua curtipendula	Sideoats Gama	2.0 PLS#
Bouteloua gracilis	Blue Gama	1.0 PLS#
		20.8 PLS#/ACRE
*All varieties must be 95% pure seed, must have a minimum 95% germination rate, and have a maximum 2% weed seed content.		

2.1.4 Seed Mixture by Weight

Temporary seeding shall be per Colorado standard erosion and sediment control standards.

2.2 TOPSOIL

2.2.1 On-Site Topsoil

Soil shall be as specified in section 32 93 00.

2.2.2 Composition

Containing from 5 to 8 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 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:

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with "composition" standard for topsoil as specified herein. Conditioners shall be as specified in section 32 93 00.

2.4 FERTILIZER

Fertilizer shall be as specified in section 32 93 00.2.5 MULCH

Mulch shall be as specified in section 32 93 00.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw must contain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay must be sterile, containing no fertile seed.

2.6 WATER

Source of water must be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

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 on-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate pH adjusters and soil conditioners into soil a minimum depth of 6 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

Application rates shall be as specified in section 32 93 00.

3.1.1.3 Fertilizer Application Rates

Fertilizer rates shall be as specified in section 32 93 00.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when

ground is muddy, frozen, snow covered, or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method must be broadcasted and drop seeding.

3.2.2.1 Broadcast and Drop Seeding

Seed must be uniformly broadcast at the rate of 20.8 lbs/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 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

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 3 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.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 32 - EXTERIOR IMPROVEMENTS

SECTION 32 93 00

EXTERIOR PLANTS

08/17

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Topsoil Composition Tests
 - 1.4.2 Nursery Certifications
 - 1.4.3 State Landscape Contractor's License
 - 1.4.4 Plant Material Photographs
 - 1.4.5 Percolation Test
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - 1.5.1 Delivery
 - 1.5.1.1 Branched Plant Delivery
 - 1.5.1.2 Soil Amendment Delivery
 - 1.5.1.3 Plant Labels
 - 1.5.2 Storage
 - 1.5.2.1 Plant Storage and Protection
 - 1.5.2.2 Fertilizer and Mulch Storage
 - 1.5.2.3 Topsoil
 - 1.5.2.4 Weed Control Fabric
 - 1.5.3 Handling
 - 1.5.4 TIME LIMITATION
- 1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS
 - 1.6.1 Planting Dates
 - 1.6.1.1 Deciduous Material
 - 1.6.1.2 Evergreen Material
 - 1.6.2 Restrictions
- 1.7 GUARANTEE
- 1.8 PLASTIC IDENTIFICATION

PART 2 PRODUCTS

- 2.1 PLANTS
 - 2.1.1 Regulations and Varieties
 - 2.1.2 Shape and Condition
 - 2.1.2.1 Deciduous Trees and Shrubs
 - 2.1.2.2 Evergreen Trees and Shrubs
 - 2.1.2.3 Ground Covers and Vines
 - 2.1.3 Plant Size
 - 2.1.4 Root Ball Size
 - 2.1.4.1 Mycorrhizal fungi inoculum
 - 2.1.5 Growth of Trunk and Crown
 - 2.1.5.1 Deciduous Trees
 - 2.1.5.2 Deciduous Shrubs
 - 2.1.5.3 Coniferous Evergreen Plant Material

- 2.1.5.4 Broadleaf Evergreen Plant Material
- 2.2 TOPSOIL
 - 2.2.1 On-Site Topsoil
 - 2.2.2 Off-Site Topsoil
 - 2.2.3 Composition
- 2.3 SOIL CONDITIONERS
 - 2.3.1 Lime
 - 2.3.2 Aluminum Sulfate
 - 2.3.3 Sulfur
 - 2.3.4 Iron
 - 2.3.5 Sand
 - 2.3.6 Perlite
 - 2.3.7 Composted Derivatives
 - 2.3.7.1 Particle Size
 - 2.3.7.2 Nitrogen Content
 - 2.3.8 Gypsum
- 2.4 PLANTING SOIL MIXTURES
- 2.5 FERTILIZER
- 2.6 WEED CONTROL FABRIC
 - 2.6.1 Roll Type Polypropylene or Polyester Mats
- 2.7 MULCH
 - 2.7.1 Inert Mulch Materials
 - 2.7.2 Organic Mulch Materials
 - 2.7.3 Recycled Organic Mulch
- 2.8 STAKING AND GUYING MATERIAL
 - 2.8.1 Staking Material
 - 2.8.1.1 Tree Support Stakes
 - 2.8.1.2 Ground Stakes
 - 2.8.2 Guying Material
 - 2.8.2.1 Guying Wire
 - 2.8.2.2 Guying Cable
 - 2.8.3 Hose Chafing Guards
 - 2.8.4 Flags
 - 2.8.5 Turnbuckles
- 2.9 ANTIDESICCANTS
- 2.10 WATER
- 2.11 MYCORRHIZAL FUNGI INOCULUM
- 2.12 SOURCE QUALITY CONTROL
- 2.13 ROOT BARRIERS

PART 3 EXECUTION

- 3.1 EXTENT OF WORK
- 3.2 PREPARATION
 - 3.2.1 Layout
 - 3.2.2 Soil Preparation
 - 3.2.2.1 pH Adjuster Application Rates
 - 3.2.2.2 Soil Conditioner Application Rates
 - 3.2.2.3 Fertilizer Application Rates
- 3.3 PLANT BED PREPARATION
- 3.4 PLANT INSTALLATION
 - 3.4.1 Individual Plant Pit Excavation
 - 3.4.2 Plant Beds with Multiple Plants
 - 3.4.3 Handling and Setting
 - 3.4.3.1 Balled and Burlapped Stock
 - 3.4.3.2 Container Grown Stock
 - 3.4.4 Earth Mounded Watering Basin for Individual Plant Pits
 - 3.4.5 Weed Control Fabric Installation
 - 3.4.6 Placement of Mulch Topdressing

- 3.4.7 Mulch Topdressing
- 3.4.8 Fertilization
 - 3.4.8.1 Granular Fertilizer
- 3.4.9 Watering
- 3.4.10 Staking and Guying
 - 3.4.10.1 Staking
 - 3.4.10.2 Guying
 - 3.4.10.3 Chafing Guards
 - 3.4.10.4 Wood Ground Stakes
 - 3.4.10.5 Flags
- 3.4.11 Pruning
 - 3.4.11.1 Trees and Shrubs
 - 3.4.11.2 Wound Dressing
- 3.5 RESTORATION AND CLEAN UP
 - 3.5.1 Restoration
 - 3.5.2 Clean Up

-- End of Section Table of Contents --

SECTION 32 93 00

EXTERIOR PLANTS

08/17

PART 1 GENERAL

1.1 REFERENCES

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

AMERICANHORT (AH)

ANSI/ANLA Z60.1 (2004) American Standard for Nursery Stock

ASTM INTERNATIONAL (ASTM)

ASTM A580/A580M (2018) Standard Specification for
Stainless Steel Wire

ASTM C602 (2020) Agricultural Liming Materials

ASTM D4972 (2018) Standard Test Methods for pH of
Soils

ASTM D5268 (2019) Topsoil Used for Landscaping
Purposes

ASTM D6155 (2019) Nontraditional Coarse Aggregate for
Bituminous Paving Mixtures

L.H. BAILEY HORTORIUM (LHBH)

LHBH (1976) Hortus Third

TREE CARE INDUSTRY ASSOCIATION (TCIA)

TCIA A300P1 (2017) ANSI A300 Part1: Tree Care
Operations - Trees, Shrubs and Other Woody
Plant Maintenance Standard Practices -
Pruning

TCIA Z133 (2017) American National Standard for
Arboricultural Operations - Pruning,
Repairing, Maintaining, and Removing
Trees, and Cutting Brush - Safety
Requirements

U.S. DEPARTMENT OF AGRICULTURE (USDA)

DOA SSIR 42 (1996) Soil Survey Investigation Report
No. 42, Soil Survey Laboratory Methods
Manual, Version 3.0

1.2 RELATED REQUIREMENTS

Section 31 00 00 EARTHWORK, Section 32 92 19 SEEDING, and Section 32 05 33 LANDSCAPE ESTABLISHMENT applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

State Landscape Contractor's License

Time Restrictions and Planting Conditions

Indicate anticipated dates and locations for each type of planting.

SD-03 Product Data

Organic Mulch Materials

Gypsum

Mulch; G

Ground Stakes

Fertilizer

Weed Control Fabric; G

Staking Material

Antidesiccants

Photographs; G

SD-04 Samples

Mulch; G

Submit one pint of mulch.

SD-06 Test Reports

Topsoil Composition Tests; ; Soil Test of proposed area; Soil Test location map

Percolation Test; Percolation Test of proposed area

SD-07 Certificates

Nursery Certifications

SD-10 Operation and Maintenance Data

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

1.4 QUALITY ASSURANCE

1.4.1 Topsoil Composition Tests

Commercial test from an independent testing laboratory including basic soil groups (moisture and saturation percentages, Nitrogen-Phosphorus-Potassium (N-P-K) ratio, pH (ASTM D4972), soil salinity), secondary nutrient groups (calcium, magnesium, sodium, Sodium Absorption Ratio (SAR)), micronutrients (zinc, manganese, iron, copper), toxic soil elements (boron, chloride, sulfate), cation exchange and base saturation percentages, and soil amendment and fertilizer recommendations with quantities for plant material being transplanted. Soil required for each test must include a maximum depth of 12 inches of approximately one quart volume for each test. Areas sampled should not be larger than 1/4 acre and should contain at least 6-8 cores for each sample area and be thoroughly mixed. Problem areas should be sampled separately and compared with samples taken from adjacent non-problem areas. The location of the sample areas should be noted and marked on a parcel or planting map for future reference.

1.4.2 Nursery Certifications

- a. Indicate on nursery letterhead the name of plants in accordance with the LHBH, including botanical common names, quality, and size.
- b. Inspection certificate.
- c. Mycorrhizal fungi inoculum for plant material treated

1.4.3 State Landscape Contractor's License

Construction company must hold a landscape contractors license in the state where the work is performed and have a minimum of five years landscape construction experience. Submit copy of license and three references for similar work completed in the last five years.

1.4.4 Plant Material Photographs

Contractor must submit nursery photographs, for government approval prior to ordering, for each tree larger than 24-inch box/ 2-inch caliper size.

1.4.5 Percolation Test

Immediately following rough grading operation, identify a typical location for one of the largest trees and or shrubs and excavate a pit per the project details. Fill the pit with water to a depth of 12 inches. The length of time required for the water to percolate into the soil, leaving the pit empty, must be measured by the project Landscape Architect and

verified by the Contracting Officer. Within six hours of the time the water has drained from the pit, the Contractor, with the Contracting Officer and project Landscape Architect present, must again fill the pit with water to a depth of 12 inches. If the water does not completely percolate into the soil within 9 hours, a determination must be made whether a drainage system or a soil penetrant will be required for each tree and or shrub being transplanted.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Branched Plant Delivery

Deliver with branches tied and exposed branches covered with material which allows air circulation. Prevent damage to branches, trunks, root systems, and root balls and desiccation of leaves.

1.5.1.2 Soil Amendment Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, or trademark, and indication of conformance to state and federal laws.

1.5.1.3 Plant Labels

Deliver plants with durable waterproof labels in weather-resistant ink. Provide labels stating the correct botanical and common plant name and variety as applicable and size as specified in the list of required plants. Attach to plants, bundles, and containers of plants. Groups of plants may be labeled by tagging one plant. Labels must be legible for a minimum of 60 days after delivery to the planting site.

1.5.2 Storage

1.5.2.1 Plant Storage and Protection

Store and protect plants not planted on the day of arrival at the site as follows:

- a. Shade and protect plants in outside storage areas from the wind and direct sunlight until planted.
- b. Protect balled and burlapped plants from freezing or drying out by covering the balls or roots with moist burlap, sawdust, wood chips, shredded bark, peat moss, or other approved material. Provide covering which allows air circulation.
- c. Keep plants in a moist condition until planted by watering with a fine mist spray.
- d. Do not store plant material directly on concrete or bituminous surfaces.

1.5.2.2 Fertilizer and Mulch Storage

Store in dry locations away from contaminants.

1.5.2.3 Topsoil

Prior to stockpiling topsoil, eradicate on site undesirable growing vegetation. Clear and grub existing vegetation three to four weeks prior to stockpiling existing topsoil.

1.5.2.4 Weed Control Fabric

Store materials on site in enclosures or under protective covering in dry location. Store under cover out of direct sunlight. Do not store materials directly on ground.

1.5.3 Handling

Do not drop or dump plants from vehicles. Avoid damaging plants being moved from nursery or storage area to planting site. Handle balled and burlapped, balled and potted, and container plants carefully to avoid damaging or breaking the earth ball or root structure. Do not handle plants by the trunk or stem. Remove damaged plants from the site.

1.5.4 TIME LIMITATION

Except for container-grown plant material, the time limitation from digging to installing plant material must be a maximum of 90 days. The time limitation between installing the plant material and placing the mulch must be a maximum of 24 hours.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Planting Dates

1.6.1.1 Deciduous Material

Deciduous material from April 15 to June 1 for spring /summer planting and from August 15 to Oct 15 for fall /winter planting.

1.6.1.2 Evergreen Material

Evergreen material from April 15 to June 1 for spring /summer planting and from August 15 to Oct 15 for fall /winter planting.

1.6.2 Restrictions

Do not plant when ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit

1.7 GUARANTEE

All plants must be guaranteed for one year beginning on the date of inspection by the Contracting Officer to commence the plant establishment period, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by the Government or by weather conditions unusual for the warranty period.

At end of warranty period, replace planting materials that die or have 25 percent or more of their branches that die during the construction operations or the guarantee period.

1.8 PLASTIC IDENTIFICATION

Provide product data indicating polymeric information in Operation and Maintenance Manual.

- Type 1: Polyethylene Terephthalate (PET, PETE).
- Type 2: High Density Polyethylene (HDPE).
- Type 3: Vinyl (Polyvinyl Chloride or PVC).
- Type 4: Low Density Polyethylene (LDPE).
- Type 5: Polypropylene (PP).
- Type 6: Polystyrene (PS).

PART 2 PRODUCTS

2.1 PLANTS

2.1.1 Regulations and Varieties

Furnish nursery stock in accordance with ANSI/ANLA Z60.1, except as otherwise specified or indicated. Each plant or group of planting must have a "key" number indicated on the nursery certifications of the plant schedule. Furnish plants, including turf grass, grown under climatic conditions similar to those in the locality of the project. Spray plants budding into leaf or having soft growth with an antidesiccant before digging. Plants of the same specified size must be of uniform size and character of growth. All plants must comply with all Federal and State Laws requiring inspection for plant diseases and infestation.

2.1.2 Shape and Condition

Well-branched, well-formed, sound, vigorous, healthy planting stock free from disease, sunscald, windburn, abrasion, and harmful insects or insect eggs and having a healthy, normal, and undamaged root system.

2.1.2.1 Deciduous Trees and Shrubs

Symmetrically developed and of uniform habit of growth, with straight boles or stems, and free from objectionable disfigurements.

2.1.2.2 Evergreen Trees and Shrubs

Well developed symmetrical tops with typical spread of branches for each particular species or variety.

2.1.2.3 Ground Covers and Vines

Number and length of runners and clump sizes indicated, and of the proper age for the grade of plants indicated, furnished in removable containers, integral containers, or formed homogeneous soil section.

2.1.3 Plant Size

Minimum sizes measured after pruning and with branches in normal position, must conform to measurements indicated, based on the average width or height of the plant for the species as specified in ANSI/ANLA Z60.1. Plants larger in size than specified may be provided with approval of the Contracting Officer. When larger plants are provided, increase the ball of earth or spread of roots in accordance with ANSI/ANLA Z60.1.

2.1.4 Root Ball Size

All box-grown, field potted, field boxed, collected, plantation grown, bare root, balled and burlapped, container grown, processed-balled, and in-ground fabric bag-grown root balls must conform to ANSI/ANLA Z60.1. All wrappings and ties must be biodegradable. Root growth in container grown plants must be sufficient to hold earth intact when removed from containers. Root bound plants will not be accepted.

2.1.4.1 Mycorrhizal fungi inoculum

Before shipment, root systems must contain mycorrhizal fungi inoculum.

2.1.5 Growth of Trunk and Crown

2.1.5.1 Deciduous Trees

A height to caliper relationship must be provided in accordance with ANSI/ANLA Z60.1. Height of branching must bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees must not be "poled" or the leader removed.

- a. Single stem: The trunk must be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: All countable stems, in aggregate, must average the size specified. To be considered a stem, there must be no division of the trunk which branches more than 6 inches from ground level.

2.1.5.2 Deciduous Shrubs

Deciduous shrubs must have the height and number of primary stems recommended by ANSI/ANLA Z60.1. Acceptable plant material must be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.5.3 Coniferous Evergreen Plant Material

Coniferous Evergreen plant material must have the height-to-spread ratio recommended by ANSI/ANLA Z60.1. The coniferous evergreen trees must not be "poled" or the leader removed. Acceptable plant material must be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired must be as indicated.

2.1.5.4 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material must have the height-to-spread ratio recommended by ANSI/ANLA Z60.1. Acceptable plant material must be well shaped and recognized by the trade as typical for the variety grown in the region of the project.

2.2 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

Evaluate soil for use as topsoil in accordance with ASTM D5268. From 4 to 6 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, plants, 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

Provide singly or in combination as required to meet specified requirements for topsoil. Soil conditioners must be nontoxic to plants.

2.3.1 Lime

Commercial grade hydrated 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, invasive species, including seeds, 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.

2.4 PLANTING SOIL MIXTURES

100 percent topsoil as specified herein.

100 percent on-site topsoil amended to meet the requirements specified.

2.5 FERTILIZER

See fertilizer requirements per Section 32 05 33.

2.6 WEED CONTROL FABRIC

2.6.1 Roll Type Polypropylene or Polyester Mats

Fabric must be woven, needle punched or non-woven and treated for protection against deterioration due to ultraviolet radiation. Fabric must be minimum 99 percent opaque to prevent photosynthesis and seed germination from occurring, yet allowing air, water and nutrients to pass thru to the roots. Minimum weight must be 5 ounces per square yard with a minimum thickness of 20 mils with a 20 year (minimum) guarantee.

2.7 MULCH

Free from noxious weeds, mold, pesticides, or other deleterious materials.

2.7.1 Inert Mulch Materials

Provide riverbank stone, complying with ASTM D6155, ranging in size from 2 to 6 inches.

2.7.2 Organic Mulch Materials

Provide wood chips and shredded hardwood.

2.7.3 Recycled Organic Mulch

Recycled mulch may include compost, tree trimmings, or pine needles with a gradation that passes through a 2-1/2 by 2-1/2 inch screen. It must be cleaned of all sticks a minimum one inch in diameter and plastic materials a minimum 3 inches length. The material must be treated to retard the growth of mold and fungi.

2.8 STAKING AND GUYING MATERIAL

2.8.1 Staking Material

2.8.1.1 Tree Support Stakes

Rough sawn hard wood free of knots, rot, cross grain, bark, long slivers, or other defects that impair strength. Stakes must be minimum 2 inches square or 2-1/2 inch diameter by 8 feet long, pointed at one end..

2.8.1.2 Ground Stakes

Rough sawn hard wood or plastic, 2 inches square are by 3 feet long, pointed at one end.

2.8.2 Guying Material

2.8.2.1 Guying Wire

12 gauge annealed galvanized steel, ASTM A580/A580M.

2.8.2.2 Guying Cable

Minimum five-strand, 3/16 inch diameter galvanized steel cable.

2.8.3 Hose Chafing Guards

New or used 2 ply 3/4 inch diameter reinforced rubber or plastic hose, black or dark green, all of same color.

2.8.4 Flags

White surveyor's plastic tape, 6 inches long, fastened to guying wires or cables.

2.8.5 Turnbuckles

Galvanized or cadmium-plated steel with minimum 3 inch long openings fitted with screw eyes. Eye bolts must be galvanized or cadmium-plated steel with one inch diameter eyes and screw length 1-1/2 inches, minimum.

2.9 ANTIDESICCANTS

Sprayable, water insoluble vinyl-vinledine complex which produce a moisture retarding barrier not removable by rain or snow. Film must form at temperatures commonly encountered out of doors during planting season and have a moisture vapor transmission rate (MVT) of the resultant film of maximum 10 grams per 24 hours at 70 percent humidity.

2.10 WATER

Source of water to be approved by Contracting Officer and suitable quality for irrigation and must not contain elements toxic to plant life.

2.11 MYCORRHIZAL FUNGI INOCULUM

Mycorrhizal fungi inoculum must be composed of multiple-fungus inoculum as recommended by the manufacturer for the plant material specified.

2.12 SOURCE QUALITY CONTROL

The Contracting Officer will inspect plant materials at the project site and approve them. Tag plant materials for size and quality.

2.13 ROOT BARRIERS

Root barriers must be recyclable, black, 0.08"-Thick injection molded polypropylene panels 24" long with vertical root channels and integrated joining system and meet the following requirements:

Properties	Typical Value	ASTM Test Method
Tensile Strength @ yield-Wall	2.354 PSI	D638
Tensile Strength @ yield-Hinge	2.846 PSI	D638
Yield Elongation-Wall	7.44%	D638
Yield Elongation-Hinge	7.01%	D638
Flexural Modulus	119.625 PSI	D790B
Notched Izod Impact-Wall	3.84 (ft-lbs)	D256A
Rockwell Hardness r. scale-Wall	84.4	D785A

PART 3 EXECUTION

3.1 EXTENT OF WORK

Provide soil preparation, including soil conditioners and soil amendments prior to planting. Provide tree, shrub, seed, post-planting fertilizer, staking, guying, weed control fabric, and mulch topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.2 PREPARATION

3.2.1 Layout

Stake out approved plant material locations and planter bed outlines on the project site before digging plant pits or beds. The Contracting Officer reserves the right to adjust plant material locations to meet

field conditions. Do not plant closer than 36 inches to a building wall, pavement edge, fence or wall edge and other similar structures.

3.2.2 Soil Preparation

3.2.2.1 pH Adjuster Application Rates

Apply pH adjuster at rates as determined by laboratory soil analysis of the soils at the job site. For bidding purposes only apply at rates for the following:

Lime 50 pounds per 1000 square feet

Sulfur 20 pounds per 1000 square feet

3.2.2.2 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:

Compost Derivatives 4 cubic yards per 1000 square feet

Rotted Manure 4 cubic yards per 1000 square feet

3.2.2.3 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 10 pounds per 1000 square feet.

3.3 PLANT BED PREPARATION

Verify location of underground utilities prior to excavation. Protect existing adjacent turf before excavations are made. Where planting beds occur in existing turf areas, remove turf to a depth that will ensure removal of entire root system. Measure depth of plant pits from finished grade. Depth of plant pit excavation must be as indicated and provide proper relation between top of root ball and finished grade. Install plant material as specified in paragraph PLANT INSTALLATION. Do not install trees within 10 feet of any utility lines or building walls.

3.4 PLANT INSTALLATION

3.4.1 Individual Plant Pit Excavation

Excavate pits at least twice as large in diameter as the size of ball or container to depth shown.

3.4.2 Plant Beds with Multiple Plants

Excavate plant beds continuously throughout entire bed as outlined to depth shown.

3.4.3 Handling and Setting

Move plant materials only by supporting the root ball . Set plants on hand compacted layer of prepared backfill soil mixture 6 inches thick Set plants on native soil and hold plumb in the center of the pit until soil has been tamped firmly around root ball. Set plant materials, in relation to surrounding finish grade, 2 inches above depth at which they were grown in the nursery, collecting field or container. Replace plant material whose root balls are cracked or damaged either before or during the planting process.

Plant material must be set in plant beds according to the drawings. Backfill soil mixture must be placed on previously scarified subsoil to completely surround the root balls, and must be brought to a smooth and even surface, blending to existing areas.

3.4.3.1 Balled and Burlapped Stock

Backfill with topsoil to approximately half the depth of ball and then tamp and water. Carefully remove or fold back excess burlap and tying materials from the top a minimum 1/2 depth from the top of the rootball. Tamp and complete backfill, place mulch topdressing, and water. Remove wires and non-biodegradable materials from plant pit prior to backfill operations.

3.4.3.2 Container Grown Stock

Remove from container and prevent damage to plant or root system.

3.4.4 Earth Mounded Watering Basin for Individual Plant Pits

Form with topsoil around each plant by replacing a mound of topsoil around the edge of each plant pit. Watering basins must be 6 inches deep for trees and 4 inches deep for shrubs. Eliminate basins around plants in plant beds containing multiple plants.

3.4.5 Weed Control Fabric Installation

Remove grass and weed vegetation, including roots, from within the area enclosed by edging. Completely cover areas enclosed by edging with specified weed control fabric prior to placing mulch layer. Overlap cut edges 6 inches.

3.4.6 Placement of Mulch Topdressing

Place specified mulch topdressing on top of weed control fabric covering total area enclosed by edging. Place mulch topdressing to a depth of 3 inches.

3.4.7 Mulch Topdressing

Provide mulch topdressing over entire planter bed surfaces and individual plant surfaces including earth mound watering basin around plants to a depth of 3 inches after completion of plant installation and before watering. Keep mulch out of the crowns of shrubs. Place mulch a minimum 2 to 3 inches away from trunk of shrub or tree. Place on top of any weed control fabric.

3.4.8 Fertilization

3.4.8.1 Granular Fertilizer

Apply granular fertilizer as a top coat prior to placing mulch layer and water thoroughly.

3.4.9 Watering

Start watering areas planted as required by temperature and wind conditions. Apply water at a rate sufficient to ensure thorough wetting of soil to a depth of 12 inches without run off.

3.4.10 Staking and Guying

3.4.10.1 Staking

Stake plants with the number of stakes indicated complete with strand of 12 gage guy wire as detailed.

3.4.10.2 Guying

Guy plants as indicated.

3.4.10.3 Chafing Guards

Use hose chafing guards, as specified where guy will contact the plant.

3.4.10.4 Wood Ground Stakes

Drive wood ground stakes into firm ground outside of plant pit with top of stake flush with ground. Place equal distance from tree trunk and around the plant pit.

3.4.10.5 Flags

Securely fasten flags on each guy as indicated.

3.4.11 Pruning

Prune in accordance with safety requirement of TCIA Z133.

3.4.11.1 Trees and Shrubs

Remove dead and broken branches. Prune to correct structural defects only. Retain typical growth shape of individual plants with as much height and spread as practical. Do not cut central leader on trees. Make cuts with sharp instruments. Do not flush cut with trunk or adjacent branches. Collars must remain in place. Pruning must be accomplished by trained and experienced personnel and must be accordance with TCIA A300P1.

3.4.11.2 Wound Dressing

Do not apply tree wound dressing to cuts.

3.5 RESTORATION AND CLEAN UP

3.5.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation must be restored to original condition at the Contractor's expense.

3.5.2 Clean Up

Excess and waste material must be removed from the installed area and must be disposed offsite at an approved landfill, recycling center, or composting center.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING

02/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
 - 1.2.1 Water Transmission Mains
 - 1.2.2 Water Mains
 - 1.2.3 Water Service Lines
 - 1.2.4 Additional Definitions
- 1.3 SUBMITTALS
- 1.4 QUALITY CONTROL
 - 1.4.1 Regulatory Requirements
 - 1.4.2 Qualifications
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - 1.5.1 Delivery and Storage
 - 1.5.2 Handling

PART 2 PRODUCTS

- 2.1 MATERIALS
 - 2.1.1 Pipe, Fittings, Joints And Couplings
 - 2.1.1.1 Ductile-Iron Piping
 - 2.1.1.1.1 Pipe and Fittings
 - 2.1.1.1.2 Joints and Jointing Material
 - 2.1.1.2 Plastic Piping
 - 2.1.1.2.1 PVC Piping
 - 2.1.1.2.1.1 PVC Piping
 - 2.1.1.2.1.2 Fittings for PVC Pipe
 - 2.1.1.2.1.3 Joints and Jointing Material for PVC Piping
 - 2.1.2 Valves
 - 2.1.2.1 Gate Valves 3 Inch Size and Larger on Buried Piping
 - 2.1.2.2 Valve Boxes
 - 2.1.3 Fire Hydrants And Hose Houses
 - 2.1.3.1 Fire Hydrants
 - 2.1.3.1.1 Dry-Barrel Type Fire Hydrants
 - 2.1.4 Disinfection
- 2.2 ACCESSORIES
 - 2.2.1 Pipe Restraint
 - 2.2.1.1 Thrust Blocks
 - 2.2.1.2 Joint Restraint
 - 2.2.2 Dielectric Fittings
 - 2.2.3 Tracer Wire for Nonmetallic Piping

PART 3 EXECUTION

- 3.1 PREPARATION
 - 3.1.1 Connections to Existing System

- 3.1.2 Operation of Existing Valves
- 3.1.3 Earthwork
- 3.2 INSTALLATION
 - 3.2.1 Piping
 - 3.2.1.1 General Requirements
 - 3.2.1.1.1 Termination of Water Lines
 - 3.2.1.1.2 Pipe Laying and Jointing
 - 3.2.1.1.3 Tracer Wire
 - 3.2.1.1.4 Connections to Existing Water Lines
 - 3.2.1.1.5 Sewer Manholes
 - 3.2.1.1.6 Water Piping Parallel With Sewer Piping
 - 3.2.1.1.7 Water Piping Crossing Sewer Piping
 - 3.2.1.2 Ductile-Iron Piping
 - 3.2.1.3 PVC Water Main Pipe
 - 3.2.1.4 Metallic Piping for Service Lines
 - 3.2.1.4.1 Screwed Joints
 - 3.2.1.5 Water Service Piping
 - 3.2.1.5.1 Location
 - 3.2.1.5.2 Water Service Line Connections to Water Mains
 - 3.2.2 Disinfection
 - 3.2.3 Flushing
 - 3.2.4 Pipe Restraint
 - 3.2.4.1 Concrete Thrust Blocks
 - 3.2.4.2 Restrained Joints
 - 3.2.5 Valves
 - 3.2.5.1 Gate Valves
 - 3.2.6 Fire Hydrants
- 3.3 FIELD QUALITY CONTROL
 - 3.3.1 Tests
 - 3.3.1.1 Hydrostatic Test
 - 3.3.1.2 Leakage Test
 - 3.3.1.3 Bacteriological Testing
 - 3.3.1.4 Special Testing Requirements for Fire Service
 - 3.3.1.5 Tracer Wire Continuity Test
- 3.4 SYSTEM STARTUP
- 3.5 CLEANUP

-- End of Section Table of Contents --

SECTION 33 11 00

WATER UTILITY DISTRIBUTION PIPING
02/18

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(2018) Hypochlorites
AWWA B301	(2018) Liquid Chlorine
AWWA C104/A21.4	(2016) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	(2018) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	(2012) Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	(2017) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	(2017) Ductile-Iron Pipe, Centrifugally Cast
AWWA C153/A21.53	(2019) Ductile-Iron Compact Fittings for Water Service
AWWA C500	(20019) Metal-Seated Gate Valves for Water Supply Service
AWWA C502	(2018) Dry-Barrel Fire Hydrants
AWWA C509	(2015) Resilient-Seated Gate Valves for Water Supply Service
AWWA C515	(2020) Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances
AWWA C605	(2014) Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVC0) Pressure Pipe and Fittings
AWWA C651	(2014) Standard for Disinfecting Water

Mains

AWWA C655	(2009) Field Dechlorination
AWWA C800	(2014) Underground Service Line Valves and Fittings
AWWA C900	(2016) Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm)
AWWA M9	(2008; Errata 2013) Manual: Concrete Pressure Pipe
AWWA M23	(2020) Manual: PVC Pipe - Design and Installation - Third Edition
AWWA M41	(2009; 3rd Ed) Ductile-Iron Pipe and Fittings

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2016) Standard Specification for Gray Iron Castings
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D3139	(2019) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F477	(2014) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F1674	(2011) Standard Test Method for Joint Restraint Products for Use with PVC Pipe
ASTM F2164	(2018) Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(2019; TIA 19-1) Standard for the Installation of Private Fire Service Mains and Their Appurtenances
---------	--

NSF INTERNATIONAL (NSF)

NSF 372	(2016) Drinking Water System Components - Lead Content
---------	--

NSF/ANSI 14 (2020) Plastics Piping System Components and Related Materials

NSF/ANSI 61 (2020) Drinking Water System Components - Health Effects

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-600-01 (2016; with Change 6, 2021) Fire Protection Engineering for Facilities

UNDERWRITERS LABORATORIES (UL)

UL 246 (2011; Reprint Jul 2020) UL Standard for Safety Hydrants for Fire-Protection Service

UL 262 (2004; Reprint Oct 2011) Gate Valves for Fire-Protection Service

1.2 DEFINITIONS

1.2.1 Water Transmission Mains

Water transmission mains include water piping having diameters greater than 14 inch, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.2 Water Mains

Water mains include water piping having diameters 4 through 14 inch, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.3 Water Service Lines

Water service lines include water piping from a water main to a building service at a point approximately 5 feet from building or the point indicated on the drawings, specific materials, methods of joining and any appurtenances deemed necessary for a satisfactory system.

1.2.4 Additional Definitions

For additional definitions refer to the definitions in the applicable referenced standard.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" 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

Connections; G

SD-03 Product Data

Pipe, Fittings, Joints and Couplings; G

Valves; G

Valve Boxes; G

Fire Hydrants; G

Pipe Restraint; G

Disinfection Procedures; G

SD-06 Test Reports

Bacteriological Samples; G

Leakage Test

Hydrostatic Test

SD-07 Certificates

Lining

Lining for Fittings

Valves

Fire Hydrants

SD-08 Manufacturer's Instructions

Ductile Iron Piping

PVC Piping

1.4 QUALITY CONTROL

1.4.1 Regulatory Requirements

Comply with NSF/ANSI 14 or NSF/ANSI 61 and NSF 372 for materials for potable water systems; comply with lead content requirements for "lead-free" plumbing as defined by the U.S. Safe Drinking Water Act effective January 2014. Provide materials bearing the seal of the National Sanitation Foundation (NSF) for potable water service.

Comply with NFPA 24 for materials, installation, and testing of fire main piping and components.

1.4.2 Qualifications

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling and in accordance with manufacturer's instructions. Store materials on site in enclosures or under protective covering. Store

plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves, fire hydrants, and other accessories free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, fire hydrants, and other accessories in accordance with manufacturer's instructions and in a manner to ensure delivery to the trench in sound undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place other material, hooks, or pipe inside a pipe or fitting after the coating has been applied. Inspect the pipe for defects before installation. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. Clean the interior of pipe and accessories of foreign matter before being lowered into the trench and keep them clean during laying operations by plugging. Replace defective material without additional expense to the Government. Store rubber gaskets, not immediately installed, under cover or out of direct sunlight.

Handle ductile iron pipe, fittings, and accessories in accordance with AWWA C600 and AWWA M41. Handle PVC and PVC0 pipe, fittings, and accessories in accordance with AWWA C605.

PART 2 PRODUCTS

2.1 MATERIALS

Provide all materials in accordance with AWWA C800 and as indicated herein. Provide valves and fittings with pressure ratings equivalent to the pressure ratings of the pipe.

2.1.1 Pipe, Fittings, Joints And Couplings

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

2.1.1.1 Ductile-Iron Piping

2.1.1.1.1 Pipe and Fittings

Pipe, AWWA C151/A21.51, Thickness Class 52. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53; fittings with push-on joint ends are to meet the same requirements as fittings with mechanical-joint ends, except for the factory modified bell design. Provide fittings with pressure ratings equivalent to that of the pipe. Provide compatible pipe ends and fittings for the specified joints. Provide cement-mortar lining, AWWA C104/A21.4, standard thickness on pipe and fittings.

2.1.1.1.2 Joints and Jointing Material

Provide push-on joints or mechanical joints for pipe and fittings. Provide mechanical joints where indicated.

- a. Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly as recommended in AWWA C111/A21.11.

- b. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets as recommended in AWWA C111/A21.11.

2.1.1.2 Plastic Piping

2.1.1.2.1 PVC Piping

2.1.1.2.1.1 PVC Piping

AWWA C900 plain end or gasket bell end pipe meeting or exceeding ASTM D1784 cell class 12454, with a minimum Pressure Class 250 (DR17) with ductile iron outside diameter (DIOD).

2.1.1.2.1.2 Fittings for PVC Pipe

Gray iron or ductile iron fittings, AWWA C110/A21.10 with special fittings in accordance with Appendix B or AWWA C153/A21.53, with cement-mortar lining for fittings, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends are to conform to the same requirements as fittings with mechanical-joint ends, except for the factory modified bell design compatible for use with PVC pipe as specified.

2.1.1.2.1.3 Joints and Jointing Material for PVC Piping

- a. Push-on joints: Use jointing material in accordance with ASTM D3139 and AWWA C111/A21.11 between pipes, pipes and metal fittings, valves, and other accessories or compression-type joints/mechanical joints. Provide each joint connection with an elastomeric gasket compatible for the bell or coupling used. Gaskets for push-on joints for pipe, ASTM F477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints.
- b. Mechanical Joint: Use mechanically coupled joints having a sleeve-type mechanical coupling, as specified in the paragraph SLEEVE-TYPE MECHANICAL COUPLINGS, as an optional jointing method for plain-end PVC pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling as specified for compression-type joints in ASTM D3139. Provide jointing material in accordance with AWWA C111/A21.11 between pipe and sleeve-type mechanical couplings.

2.1.2 Valves

2.1.2.1 Gate Valves 3 Inch Size and Larger on Buried Piping

AWWA C500, AWWA C509, AWWA C515, or UL 262 and:

- a. AWWA C500: nonrising stem type with double-disc gate and mechanical-joint ends or push-on joint ends compatible for the adjoining pipe
- b. AWWA C509 or AWWA C515: nonrising stem type with mechanical-joint ends or resilient-seated gate valves 3 to 12 inches in size

Gate valves open by counterclockwise rotation of the valve stem. Stuffing

boxes have O-ring stem seals. Stuffing boxes are bolted and constructed so as to permit easy removal of parts for repair. Where an indicator post are shown, provide an indicator post flange for AWWA C500, AWWA C509, or AWWA C515 gate valves conforming to the requirements of UL 262. Gate valves on 4 inch service lines have ends compatible with joining to the pipe used; push-on joint ends or mechanical-joint ends for joining to ductile-iron pipe or push-on joint ends or mechanical-joint ends for joining to PVC water main pipe; with AWWA C111/A21.11 gaskets and pipe ends. Provide all valves from one manufacturer.

2.1.2.2 Valve Boxes

Provide a valve box for each gate valve on buried piping, except where indicator post is shown. Construct adjustable valve boxes manufactured from cast iron of a size compatible for the valve on which it is used. Provide cast iron valve boxes with a minimum cover and wall thickness of 3/16 inch and conforming to ASTM A48/A48M, Class 35B. Coat the cast-iron box with a heavy coat of bituminous paint. Provide a round head. Cast the word "WATER" on the lid. The minimum diameter of the shaft of the box is 5 1/4 inches.

2.1.3 Fire Hydrants And Hose Houses

2.1.3.1 Fire Hydrants

Provide fire hydrants where indicated. Paint fire hydrants with at least one coat of primer and two coats of enamel paint. Paint barrel and bonnet colors in accordance with UFC 3-600-01. Stencil fire hydrant number and main size on the fire hydrant barrel using black stencil paint.

2.1.3.1.1 Dry-Barrel Type Fire Hydrants

Provide Dry-barrel type fire hydrants, AWWA C502 or UL 246, "Base Valve" with 6 inch inlet, 5 1/4 inch valve opening, one 4 1/2 inch pumper connection, and two 2 1/2 inch hose connections.

Provide mechanical-joint end only inlet; with end matching requirements as specified in AWWA C502 for size and shape of operating nut, cap nuts, and threads on hose and pumper connections. Provide fire hydrants with frangible sections as mentioned in AWWA C502. Provide fire hydrant with special couplings joining upper and lower sections of fire hydrant barrel that break from a force imposed by a moving vehicle.

2.1.4 Disinfection

Chlorinating materials are to conform to: Chlorine, Liquid: AWWA B301; Hypochlorite, Calcium and Sodium: AWWA B300.

2.2 ACCESSORIES

2.2.1 Pipe Restraint

2.2.1.1 Thrust Blocks

Use ASTM C94/C94M concrete having a minimum compressive strength of 2,500 psi at 28 days.

2.2.1.2 Joint Restraint

Provide restrained joints in accordance with NFPA 24, Chapter 10 and in accordance with ASTM F1674.

Provide mechanical joint restraint meeting the requirements of AWWA C110/A21.10.

2.2.2 Dielectric Fittings

Install dielectric fittings between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains to prevent metal-to-metal contact of dissimilar metallic piping elements and compatible with the indicated working pressure.

2.2.3 Tracer Wire for Nonmetallic Piping

Provide a continuous bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length over each separate run of nonmetallic pipe.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Connections to Existing System

Perform all connections to the existing water system in the presence of the Contracting Officer.

3.1.2 Operation of Existing Valves

Do not operate valves within or directly connected to the existing water system unless expressly directed to do so by the Contracting Officer.

3.1.3 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.2 INSTALLATION

Install all materials in accordance with the applicable reference standard, manufacturers instructions and as indicated herein.

3.2.1 Piping

3.2.1.1 General Requirements

Install pipe, fittings, joints and couplings in accordance with the applicable referenced standard, the manufacturer's instructions and as specified herein.

3.2.1.1.1 Termination of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building, unless otherwise indicated.

Do not lay water lines in the same trench with gas lines, fuel lines, electric wiring, or any other utility. Do not install copper tubing in

the same trench with ferrous piping materials. Where nonferrous metallic pipe (i.e., copper tubing) crosses any ferrous piping, provide a minimum vertical separation of 12 inches between pipes.

3.2.1.1.2 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Under no circumstances is it permissible to drop or dump pipe, fittings, valves, or other water line material into trenches. Cut pipe cleanly, squarely, and accurately to the length established at the site and work into place without springing or forcing. Replace a pipe or fitting that does not allow sufficient space for installation of jointing material. Blocking or wedging between bells and spigots is not permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at the design elevation and grade. Secure firm, uniform support. Wood support blocking is not permitted. Lay pipe so that the full length of each section of pipe and each fitting rests solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports for fastening work into place. Make provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been assembled. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation.

3.2.1.1.3 Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.2.1.1.4 Connections to Existing Water Lines

Make connections to existing water lines after coordination with the facility and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped and as indicated, except as otherwise specified, tap concrete pipe in accordance with AWWA M9 for tapping concrete pressure pipe.

3.2.1.1.5 Sewer Manholes

No water piping is to pass through or come in contact with any part of a sewer manhole.

3.2.1.1.6 Water Piping Parallel With Sewer Piping

Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer than 10 feet, horizontally, from any sewer line.

3.2.1.1.7 Water Piping Crossing Sewer Piping

Provide at least 18 inches above the top (crown) of the sewer piping and the bottom (invert) of the water piping whenever possible. Measure the distance edge-to-edge. Where water lines cross under gravity sewer lines,

construct sewer line of AWWA compliant ductile iron water piping with rubber-gasketed joints and no joint located within 10 feet, horizontally, of the crossing.

3.2.1.2 Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

- a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 and AWWA M41 for joint assembly. Make mechanical joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 and AWWA M41 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11.
- b. Allowable Deflection: Follow AWWA C600 and AWWA M41 for the maximum allowable deflection. If the alignment requires deflection in excess of the above limitations, provide special bends or a sufficient number of shorter lengths of pipe to achieve angular deflections within the limit set forth.
- c. Exterior Protection: Completely encase buried ductile iron pipelines using Method A or B, with polyethylene film, in accordance with AWWA C105/A21.5.

3.2.1.3 PVC Water Main Pipe

Unless otherwise specified, install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the requirements of AWWA C605 for laying of pipe, joining PVC pipe to fittings and accessories, setting of fire hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

- a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use a lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories, with the requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut

off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

- b. Joint Offset: Construct joint offset in accordance AWWA C605. Do not exceed the minimum longitudinal bending as indicated by AWWA C605.
- c. Fittings: Install in accordance with AWWA C605.

3.2.1.4 Metallic Piping for Service Lines

Install pipe and fittings in accordance with the paragraph GENERAL REQUIREMENTS and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

3.2.1.4.1 Screwed Joints

Make screwed joints up tight with a stiff mixture of graphite and oil, inert filler and oil, or graphite compound; apply to male threads only or with PTFE Tape, for use with threaded pipe. Threads are to be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.

3.2.1.5 Water Service Piping

3.2.1.5.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at the points indicated; close such water service lines with plugs or caps.

3.2.1.5.2 Water Service Line Connections to Water Mains

Connect 3 inch water service lines to the main as indicated.

3.2.2 Disinfection

Prior to disinfection, provide disinfection procedures, proposed neutralization and disposal methods of waste water from disinfection as part of the disinfection submittal. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Disinfect new water piping using the AWWA C651 continuous-feed method of chlorination. Ensure a free chlorine residual of not less than 10 parts per million after 24 hour holding period and prior to performing bacteriological tests.

3.2.3 Flushing

Perform bacteriological tests prior to flushing. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 to 0.5 parts per million, the residual chlorine content of the distribution system, or acceptable for domestic use. Use AWWA C655 neutralizing chemicals.

3.2.4 Pipe Restraint

3.2.4.1 Concrete Thrust Blocks

Install concrete thrust blocks where indicated.

3.2.4.2 Restrained Joints

Install restrained joints in accordance with the manufacturer's instructions where indicated.

3.2.5 Valves

3.2.5.1 Gate Valves

Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509 or AWWA C515, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509 or AWWA C515. Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Make and assemble joints to gate valves as specified for making and assembling the same type joints between pipe and fittings.

3.2.6 Fire Hydrants

Install fire hydrants in accordance with AWWA C600 for fire hydrant installation and as indicated. Make and assemble joints as specified for making and assembling the same type joints between pipe and fittings. Install fire hydrants with the 4 1/2 inch connections facing the adjacent paved surface. If there are two paved adjacent surfaces, install fire hydrants with the 4 1/2 inch connection facing the paved surface where the connecting main is located.

3.3 FIELD QUALITY CONTROL

3.3.1 Tests

Notify the Contracting Officer a minimum of five days in advance of hydrostatic testing. Coordinate the proposed method for disposal of waste water from hydrostatic testing. Perform field tests, and provide labor, equipment, and incidentals required for testing, except that water needed for field tests will be furnished as set forth in paragraph AVAILABILITY AND USE OF UTILITY SERVICES in Section 01 30 00.24 OTHER ADMINISTRATIVE AND SPECIAL REQUIREMENTS. Provide documentation that all items of work have been constructed in accordance with the Contract documents.

3.3.1.1 Hydrostatic Test

Test the water system in accordance with the applicable AWWA standard specified below. Where water mains provide fire service, test in accordance with the special testing requirements given in the paragraph SPECIAL TESTING REQUIREMENTS FOR FIRE SERVICE. Test ductile-iron water mains in accordance with the requirements of AWWA C600 for hydrostatic testing. The amount of leakage on ductile-iron pipelines with mechanical-joints or push-on joints is not to exceed the amounts given in

AWWA C600; no leakage will be allowed at joints made by any other methods. Test PVC plastic water systems made with PVC pipe in accordance with the requirements of AWWA C605 for pressure and leakage tests. The amount of leakage on pipelines made of PVC water main pipe is not to exceed the amounts given in AWWA C605, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test water service lines in accordance with requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at copper pipe joints, copper tubing joints (soldered, compression type, brazed), plastic pipe joints, and screwed joints. Do not backfill utility trench or begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 7 days after placing of the concrete.

3.3.1.2 Leakage Test

For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

For PE perform leak testing in accordance with ASTM F2164.

3.3.1.3 Bacteriological Testing

Perform bacteriological tests in accordance with AWWA C651 Option A. For new water mains use Option A and obtain two sets of samples for coliform analysis, each sample being collected at least 16 hours apart. Take samples every 1,200 ft plus one set from the end of the line and at least one from each branch greater than one pipe length. Analyze samples by a certified laboratory, and submit the results of the bacteriological samples.

3.3.1.4 Special Testing Requirements for Fire Service

Test water mains and water service lines providing fire service or water and fire service in accordance with NFPA 24. The additional water added to the system must not exceed the limits given in NFPA 24

3.3.1.5 Tracer Wire Continuity Test

Test tracer wire for continuity after service connections have been completed and prior to final pavement or restoration. Verify that tracer wire is locatable with electronic utility locating equipment. Repair breaks or separations and re-test for continuity.

3.4 SYSTEM STARTUP

Water mains and appurtenances must be completely installed, disinfected, flushed, and satisfactory bacteriological sample results received prior to permanent connections being made to the active distribution system. Obtain approval by the Contracting Officer prior to the new water piping being placed into service.

3.5 CLEANUP

Upon completion of the installation of water lines and appurtenances, remove all debris and surplus materials resulting from the work.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 30 00

SANITARY SEWERAGE

05/18

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 QUALITY CONTROL
 - 1.3.1 Installer Qualifications
- 1.4 DELIVERY, STORAGE, AND HANDLING
 - 1.4.1 Delivery and Storage
 - 1.4.1.1 Piping
 - 1.4.1.2 Cement, Aggregate, and Reinforcement
 - 1.4.2 Handling

PART 2 PRODUCTS

- 2.1 SYSTEM DESCRIPTION
 - 2.1.1 Sanitary Sewer Gravity Pipeline
- 2.2 MATERIALS
 - 2.2.1 Gravity Pipe
 - 2.2.1.1 PVC Gravity Sewer Piping
 - 2.2.1.1.1 PVC Gravity Pipe and Fittings
 - 2.2.1.1.2 PVC Gravity Joints and Jointing Material
 - 2.2.2 Cement Mortar
 - 2.2.3 Portland Cement
 - 2.2.4 Portland Cement Concrete
 - 2.2.5 Precast Concrete Manholes
 - 2.2.6 Gaskets and Connectors
 - 2.2.7 External Preformed Rubber Joint Seals
 - 2.2.8 Frames, Covers, and Gratings for Manholes
 - 2.2.9 Manhole Steps
 - 2.2.10 Manhole Ladders

PART 3 EXECUTION

- 3.1 PREPARATION
 - 3.1.1 Installation Drawings
- 3.2 INSTALLATION
 - 3.2.1 Connections to Existing Lines
 - 3.2.2 General Requirements for Installation of Pipelines
 - 3.2.2.1 Location
 - 3.2.2.1.1 Sanitary Sewer Manholes
 - 3.2.2.2 Earthwork
 - 3.2.2.3 Pipe Laying and Jointing
 - 3.2.3 Special Requirements
 - 3.2.3.1 Installation of PVC Piping
 - 3.2.4 Concrete Work
 - 3.2.5 Manhole Construction

- 3.2.6 Miscellaneous Construction and Installation
 - 3.2.6.1 Connecting to Existing Manholes
 - 3.2.6.2 Metal Work
 - 3.2.6.2.1 Workmanship and Finish
 - 3.2.6.2.2 Field Painting
 - 3.3 FIELD QUALITY CONTROL
 - 3.3.1 Tests
 - 3.3.1.1 Leakage Tests for Nonpressure Lines
 - 3.3.1.1.1 Low-Pressure Air Tests
 - 3.3.1.1.1.1 PVC Pipelines
 - 3.3.2 Inspection
 - 3.3.2.1 Post-Installation Inspection
- End of Section Table of Contents --

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.

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2016) Standard Specification for Gray Iron Castings
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM C150/C150M	(2020) Standard Specification for Portland Cement
ASTM C270	(2019) Standard Specification for Mortar for Unit Masonry
ASTM C443	(2020) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C478M	(2018) Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C972	(2000; R 2011) Compression-Recovery of Tape Sealant

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	(2007; R 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) 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 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

Contractor's License; G

SD-02 Shop Drawings

Installation Drawings; G

SD-03 Product Data

Precast Concrete Manholes

Frames, Covers, and Gratings

Gravity Pipe

SD-06 Test Reports

Low-Pressure Air Tests; G

SD-07 Certificates

Portland Cement

Gaskets

1.3 QUALITY CONTROL

1.3.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in the state where the work is to be performed. Verify installing Contractor's License is current and state certified or state registered.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.4.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.4.1.2 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

1.4.2 Handling

Handle pipe, fittings, and other accessories in such manner as to ensure delivery to the trench in sound undamaged condition. Take special care not to damage linings of pipe and fittings; if lining is damaged, make satisfactory repairs. Carry, do not drag, pipe to trench. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any

similar materials required to install the plastic pipe in accordance with the manufacturer's recommendation and discard those materials if the storage period exceeds the recommended shelf life. Discard solvents in use when the recommended pot life is exceeded.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

2.1.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of polyvinyl chloride (PVC) plastic pipe. Provide building connections of polyvinyl chloride (PVC) plastic pipe. Provide new 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 PVC Gravity Sewer Piping

2.2.1.1.1 PVC Gravity Pipe and Fittings

ASTM D3034, SDR 35, or ASTM F949 with ends suitable for elastomeric gasket joints.

2.2.1.1.2 PVC Gravity Joints and Jointing Material

Provide joints conforming to ASTM D3212. Gaskets are to conform to ASTM F477.

2.2.2 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. Use a cement containing less than 0.60 percent alkalis where aggregates are alkali reactive, as determined by Appendix XI of ASTM C33/C33M.

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 C923.

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
Tear Resistance, pli	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

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 without vent holes. Size are to be for 24 inch opening. Stamp or cast the words "Sanitary Sewer" into covers so that it is plainly visible.

2.2.9 Manhole Steps

As indicated 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.

2.2.10 Manhole Ladders

Provide a steel ladder where the depth of a manhole exceeds 12 feet. The ladder is not to be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers are to be a minimum 3/8 inch thick and 2 inches wide. Galvanize ladders and inserts after fabrication in conformance with ASTM A123/A123M.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Installation Drawings

Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

3.2 INSTALLATION

Backfill after inspection by the Contracting Officer. Before, during, and after installation, protect plastic pipe and fittings from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer.

3.2.1 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, unless otherwise indicated.

3.2.2.1.1 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 or groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to give a uniform space all around. Blocking or wedging between bells and spigots or tongues and grooves 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 Concrete Work

Cast-in-place concrete is included in Section 03 30 00 CAST-IN-PLACE CONCRETE. Support the pipe on a concrete cradle, or encased in concrete where indicated or directed.

3.2.5 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes. Perform cast-in-place concrete work in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new

manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.2.6 Miscellaneous Construction and Installation

3.2.6.1 Connecting to Existing Manholes

Connect pipe to existing manholes such that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. Center the connection on the manhole. Holes for the new pipe are to be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cut the manhole in a manner that will cause the least damage to the walls.

3.2.6.2 Metal Work

3.2.6.2.1 Workmanship and Finish

Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

3.2.6.2.2 Field Painting

After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal, remove mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.3 FIELD QUALITY CONTROL

The Contracting Officer will conduct field inspections and witness field tests specified in this section. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.3.1 Tests

Perform field tests and provide labor, equipment, and incidentals required for testing.

3.3.1.1 Leakage Tests for Nonpressure Lines

Test lines for leakage 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.

3.3.1.1.1 Low-Pressure Air Tests

3.3.1.1.1.1 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 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.

-- End of Section --

This page was intentionally left blank for duplex printing.

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 40 00

STORM DRAINAGE UTILITIES

02/10, CHG 6: 02/19

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 DELIVERY, STORAGE, AND HANDLING
 - 1.3.1 Delivery and Storage
 - 1.3.2 Handling

PART 2 PRODUCTS

- 2.1 PIPE FOR CULVERTS AND STORM DRAINS
 - 2.1.1 Concrete Pipe
 - 2.1.2 Poly Vinyl Chloride (PVC) Pipe
 - 2.1.2.1 Smooth Wall PVC Pipe
 - 2.1.2.2 Corrugated PVC Pipe
- 2.2 DRAINAGE STRUCTURES
 - 2.2.1 Flared End Sections
- 2.3 MISCELLANEOUS MATERIALS
 - 2.3.1 Concrete
 - 2.3.2 Mortar
 - 2.3.3 Precast Reinforced Concrete Manholes
 - 2.3.4 Frame and Cover for Gratings
 - 2.3.5 Joints
 - 2.3.5.1 Flexible Watertight Joints
 - 2.3.5.2 External Sealing Bands
 - 2.3.5.3 Flexible Watertight, Gasketed Joints
 - 2.3.5.4 PVC Plastic Pipes
- 2.4 RESILIENT CONNECTORS
- 2.5 EROSION CONTROL RIP RAP

PART 3 EXECUTION

- 3.1 INSTALLATION OF PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES
 - 3.1.1 Trenching
 - 3.1.2 Removal of Unstable Material
- 3.2 BEDDING
 - 3.2.1 Concrete Pipe Requirements
 - 3.2.2 Plastic Pipe
- 3.3 PLACING PIPE
 - 3.3.1 Concrete, PVC, and Ribbed PVC Pipe
- 3.4 JOINTING
 - 3.4.1 Concrete
 - 3.4.1.1 Cement-Mortar Bell-and-Spigot Joint
 - 3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe
 - 3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

- 3.4.1.4 Cement-Mortar Tongue-and-Groove Joint
- 3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe
- 3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe
- 3.4.1.7 Flexible Watertight Joints
- 3.5 DRAINAGE STRUCTURES
 - 3.5.1 Manholes and Inlets
 - 3.5.2 Headwalls
- 3.6 BACKFILLING
 - 3.6.1 Backfilling Pipe in Trenches
 - 3.6.2 Backfilling Pipe in Fill Sections
 - 3.6.3 Movement of Construction Machinery
 - 3.6.4 Compaction
 - 3.6.4.1 General Requirements
 - 3.6.4.2 Minimum Density
- 3.7 FIELD PAINTING
 - 3.7.1 Cast-Iron Covers, Frames, Gratings, And Steps
- 3.8 FIELD QUALITY CONTROL
 - 3.8.1 Tests
 - 3.8.1.1 HYDROSTATIC TEST ON WATERTIGHT JOINTS
 - 3.8.1.1.1 Concrete and PVC Pipe
 - 3.8.1.2 Determination of Density
 - 3.8.1.3 Deflection Testing
 - 3.8.1.3.1 Mandrel
 - 3.8.2 Inspection
 - 3.8.2.1 Post-Installation Inspection
 - 3.8.2.1.1 Concrete
 - 3.8.2.1.2 Flexible Pipe
 - 3.8.2.1.3 Post-Installation Inspection Report
 - 3.8.3 Repair Of Defects
 - 3.8.3.1 Deflection Testing
 - 3.8.3.2 Inspection
 - 3.8.3.2.1 Concrete
 - 3.8.3.2.2 Flexible Pipe
- 3.9 PROTECTION
- 3.10 WARRANTY PERIOD

-- End of Section Table of Contents --

SECTION 33 40 00

STORM DRAINAGE UTILITIES
02/10, CHG 6: 02/19

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 A48/A48M	(2003; R 2016) Standard Specification for Gray Iron Castings
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A929/A929M	(2018) Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B26/B26M	(2014; E 2015) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C76	(2020) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C270	(2019) Standard Specification for Mortar for Unit Masonry
ASTM C425	(2004; R 2013) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C443	(2020) Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	(2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
ASTM C877	(2021) Standard Specification for External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C923	(2008; R 2013; E 2016) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals

ASTM C990	(2009; R 2014) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM D1056	(2014) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D1171	(2016; E 2016) Standard Test Method for Rubber Deterioration - Surface Ozone Cracking Outdoors (Triangular Specimens)
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2167	(2015) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D3212	(2007; R 2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D6938	(2017a) Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F679	(2016) Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F949	(2020) Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

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-04 Samples

Pipe for Culverts and Storm Drains

SD-07 Certificates

Resin Certification

Oil Resistant Gasket

Hydrostatic Test on Watertight Joints

Determination of Density

Frame and Cover for Gratings

Post-Installation Inspection Report

SD-08 Manufacturer's Instructions

Placing Pipe

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C76, Class III.

2.1.2 Poly Vinyl Chloride (PVC) Pipe

Submit the pipe manufacturer's resin certification, indicating the cell

classification of PVC used to manufacture the pipe, prior to installation of the pipe.

2.1.2.1 Smooth Wall PVC Pipe

ASTM F679 produced from PVC certified by the Manufacturer as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.1.2.2 Corrugated PVC Pipe

ASTM F949 produced from PVC certified by the Manufacturer as meeting the requirements of ASTM D1784, minimum cell class 12454-B.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A929/A929M.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3,500 psi concrete under Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar. Water shall be clean and free of harmful acids, alkalis, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Reinforced Concrete Manholes

Conform to ASTM C478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.4 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.O-T6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.5 Joints

2.3.5.1 Flexible Watertight Joints

- a. Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for preformed flexible joint sealants shall conform to ASTM C990, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.
- b. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.5.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C877.

2.3.5.3 Flexible Watertight, Gasketed Joints

- a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D1056, Type 2 A1, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of ASTM C990 or ASTM C443. Preformed flexible joint sealants shall conform to ASTM C990, Type B.
- b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.5.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.4 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and

inlets shall conform to ASTM C923.

2.5 EROSION CONTROL RIP RAP

Provide non-erodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of as indicated.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK, and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 16 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheet piling and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheet piling, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Plastic Pipe

Bedding for PVC, PE, SRPE and PP pipe shall meet the requirements of ASTM D2321. Use Class IB or II material for bedding, haunching, and initial backfill. Use Class I, II, or III material for PP pipe bedding, haunching and initial backfill.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe, excluding SRPE pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (percent)
Plastic (PVC)	5

Note post installation requirements of paragraph DEFLECTION TESTING in PART 3 of this specification for all pipe products including deflection testing requirements for flexible pipe.

3.3.1 Concrete, PVC, and Ribbed PVC Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.4 JOINTING

3.4.1 Concrete

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established grade line, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Diaper Joint for Bell-and-Spigot Pipe

The pipe shall be centered so that the annular space is uniform. The annular space shall be caulked with jute or oakum. Before caulking, the inside of the bell and the outside of the spigot shall be cleaned.

- a. Diaper Bands: Diaper bands shall consist of heavy cloth fabric to hold grout in place at joints and shall be cut in lengths that extend one-eighth of the circumference of pipe above the spring line on one side of the pipe and up to the spring line on the other side of the pipe. Longitudinal edges of fabric bands shall be rolled and stitched around two pieces of wire. Width of fabric bands shall be such that after fabric has been securely stitched around both edges on wires, the wires will be uniformly spaced not less than 8 inches apart. Wires shall be cut into lengths to pass around pipe with sufficient extra length for the ends to be twisted at top of pipe to hold the band securely in place; bands shall be accurately centered around lower portion of joint.
- b. Grout: Grout shall be poured between band and pipe from the high side of band only, until grout rises to the top of band at the spring line of pipe, or as nearly so as possible, on the opposite side of pipe, to ensure a thorough sealing of joint around the portion of pipe covered by the band. Silt, slush, water, or polluted mortar grout forced up on the lower side shall be forced out by pouring, and removed.
- c. Remainder of Joint: The remaining unfilled upper portion of the joint shall be filled with mortar and a bead formed around the outside of this upper portion of the joint with a sufficient amount of additional mortar. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind actual laying of pipe. No backfilling around joints shall be done until joints have been fully inspected and approved.

3.4.1.4 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established grade line with the groove upstream. A shallow excavation shall be made underneath

the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.5 Cement-Mortar Diaper Joint for Tongue-and-Groove Pipe

The joint shall be of the type described for cement-mortar tongue-and-groove joint in this paragraph, except that the shallow excavation directly beneath the joint shall not be filled with mortar until after a gauze or cheesecloth band dipped in cement mortar has been wrapped around the outside of the joint. The cement-mortar bead at the joint shall be at least 1/2 inch, thick and the width of the diaper band shall be at least 8 inches. The diaper shall be left in place. Placing of this type of joint shall be kept at least five joints behind the actual laying of the pipe. Backfilling around the joints shall not be done until the joints have been fully inspected and approved.

3.4.1.6 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Sealing compounds shall be inspected before installation of the pipe, and any loose or improperly affixed sealing compound shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pulled together. If, while making the joint with mastic-type sealant, a slight protrusion of the material is not visible along the entire inner and outer circumference of the joint when the joint is pulled up, the pipe shall be removed and the joint remade. After the joint is made, all inner protrusions shall be cut off flush with the inner surface of the pipe. If non-mastic-type sealant material is used, the "Squeeze-Out" requirement above will be waived.

3.4.1.7 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, or precast reinforced concrete; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Headwalls

Construction shall be as indicated.

3.6 BACKFILLING

3.6.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of concrete pipe or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.6.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed and thoroughly compacted in layers not exceeding 8 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

3.6.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of

construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.6.4 Compaction

3.6.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.6.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

- a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 95 percent of maximum density for cohesive material and 98 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.
- b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
- c. Under nontraffic areas, density shall be not less than 85 percent of maximum density.

3.7 FIELD PAINTING

3.7.1 Cast-Iron Covers, Frames, Gratings, And Steps

After installation, clean cast-iron, not buried in masonry or concrete, of mortar, rust, grease, dirt, and other deleterious materials to bare metal and apply a coat of bituminous paint.

3.8 FIELD QUALITY CONTROL

3.8.1 Tests

Testing is the responsibility of the Contractor. Perform all testing and retesting at no additional cost to the Government.

3.8.1.1 HYDROSTATIC TEST ON WATERTIGHT JOINTS

Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed.

3.8.1.1.1 Concrete and PVC Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to ASTM C990 or ASTM C443. Test requirements for joints in clay pipe shall conform to ASTM C425. Test requirements for joints in PVC, PE, and PP plastic pipe shall conform to ASTM D3212.

3.8.1.2 Determination of Density

Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D2167 or ASTM D6938. When ASTM D6938 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D6938 results in a wet unit weight of soil and ASTM D6938 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D6938. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8.1.3 Deflection Testing

Conduct deflection test no sooner than 30 days after completion of final backfill and compaction testing. Clean or flush all lines prior to testing. Perform a deflection test on entire length of installed flexible pipeline upon completion of work adjacent to and over the pipeline, including backfilling, placement of fill, grading, paving, placement of concrete, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed limits in paragraph PLACING PIPE above as percent of the average inside diameter of pipe. Use a mandrel to determine if allowable deflection has been exceeded.

3.8.1.3.1 Mandrel

Pass the mandrel through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, stop and begin test from the opposite direction. The mandrel must meet the Pipe Manufacture's recommendations and the following requirements. Provide a Mandrel that is rigid, nonadjustable, has a minimum of 9 fins, pulling rings at each end, and is engraved with the nominal pipe size and mandrel outside diameter. The mandrel must be 5 percent less than the certified-actual pipe diameter for Plastic Pipe, 5 percent less than the certified-actual pipe diameter for Corrugated Steel and Aluminum, 3 percent less than the

certified-actual pipe diameter for Concrete-Lined Corrugated Steel and Ductile Iron Culvert. The Government will verify the outside diameter(OD)of the Contractor provided mandrel through the use of Contractor provided proving rings.

3.8.2 Inspection

3.8.2.1 Post-Installation Inspection

Visually inspect each segment of concrete pipe for alignment, settlement, joint separations, soil migration through the joint, cracks, buckling, bulging and deflection. An engineer must evaluate all defects to determine if any remediation or repair is required.

3.8.2.1.1 Concrete

Cracks with a width greater than 0.01 inches. An engineer must evaluate all pipes with cracks with a width greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required.

3.8.2.1.2 Flexible Pipe

Check each flexible pipe (PVC) for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

3.8.2.1.3 Post-Installation Inspection Report

The deflection results and final post installation inspection report must include: pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.8.3 Repair Of Defects

3.8.3.1 Deflection Testing

When deflection readings are in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection and replace with new pipe. Retest 30 days after completing backfill, leakage testing and compaction testing.

3.8.3.2 Inspection

Replace pipe or repair defects indicated in the Post-Installation Inspection Report.

3.8.3.2.1 Concrete

Replace pipes having cracks with a width greater than 0.1 inches.

3.8.3.2.2 Flexible Pipe

Replace pipes having cracks or splits.

3.9 PROTECTION

Protect storm drainage piping and adjacent areas from superimposed and external loads during construction.

3.10 WARRANTY PERIOD

Pipe segments found to have defects during the warranty period must be replaced with new pipe and retested.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 51 15

NATURAL-GAS DISTRIBUTION PIPELINES

08/19

PART 1 GENERAL

- 1.1 SUMMARY
- 1.2 REFERENCES
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Qualifications
 - 1.4.1.1 Welding General
 - 1.4.1.2 Jointing of Plastic Piping
 - 1.4.2 Pre-Installation Conference
 - 1.4.2.1 Shop Drawings
 - 1.4.2.2 Connecting and Abandonment Plan
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - 1.5.1 Delivery and Storage
 - 1.5.2 Handling
- 1.6 EXTRA MATERIALS

PART 2 PRODUCTS

- 2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS
 - 2.1.1 Steel Pipe for Natural Gas Distribution
 - 2.1.2 Corrosion Protection for Steel Pipe for Underground Installation
 - 2.1.2.1 External Coating Systems
 - 2.1.3 Steel and Malleable Iron Fittings, 1-1/2 inches and Smaller
 - 2.1.4 Steel Fittings, 2 inches and Larger
 - 2.1.5 Steel Forged Branch Connections
 - 2.1.6 Flange Gaskets
 - 2.1.7 Pipe Threads
 - 2.1.8 Sealants for Steel Pipe Threaded Joints in Natural Gas Systems
 - 2.1.8.1 Sealing Compound
 - 2.1.8.2 Tape
- 2.2 PLASTIC PIPE, TUBING, FITTINGS AND JOINTS
 - 2.2.1 Polyethylene Gas Pressure Pipe, Tubing, and Fittings
 - 2.2.2 Mechanical Fittings for use with Plastic Pipe
- 2.3 VALVES
 - 2.3.1 Carbon Steel Valves for Natural Gas Pipelines
 - 2.3.2 Excess Flow Valve (EFV)
 - 2.3.3 Valve Box
- 2.4 PRESSURE REGULATORS
 - 2.4.1 Natural Gas Main Regulators
 - 2.4.2 Natural Service Regulators
 - 2.4.3 Overpressure Protection for Service Lines, Operating Pressure Greater than 60 psig, but Less than 862 kPa/125 psig
 - 2.4.4 Overpressure Protection for Service Lines, Operating Pressure Greater than 125 psig

- 2.5 METERS
- 2.6 TELEMETERING OR RECORDING GAUGES
- 2.7 GAS TRANSITION FITTINGS
- 2.8 IDENTIFICATION
- 2.9 ELECTRICALLY ISOLATED JOINT MATERIALS

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 EXCAVATION AND BACKFILLING
- 3.3 GAS MAINS
- 3.4 SERVICE LINES
- 3.5 WORKMANSHIP AND DEFECTS
- 3.6 PROTECTIVE COATING
 - 3.6.1 Protective Coating for Underground Steel Pipe
 - 3.6.1.1 Field Plant Applied Polyolefin Resin Coating System
 - 3.6.1.2 Pipe Joint and Field Repair Coating System
 - 3.6.1.3 Inspection of Pipe Coatings
 - 3.6.2 Protective Covering for Aboveground Piping Systems
 - 3.6.2.1 Ferrous Surfaces
 - 3.6.2.2 Nonferrous Surfaces
 - 3.6.3 Protective Covering for Piping in Valve Boxes and Manholes
- 3.7 INSTALLATION
 - 3.7.1 Abandonment of Natural Gas Distribution Pipelines
 - 3.7.2 Installing Pipe Underground
 - 3.7.3 Installing Pipe Aboveground
- 3.8 PIPE JOINTS
 - 3.8.1 Threaded Steel Joints
 - 3.8.2 Welded Steel Joints
 - 3.8.3 Plastic Pipe Jointing Procedures
 - 3.8.4 Mechanical Couplings for Plastic Pipe Jointing
 - 3.8.5 Connections Between Metallic and Plastic Piping
- 3.9 VALVES
- 3.10 VALVE BOXES
- 3.11 DRIPS
- 3.12 PRESSURE REGULATOR INSTALLATION
 - 3.12.1 Main Distribution Line Regulators
 - 3.12.2 Service Line Regulators
- 3.13 METER INSTALLATION
- 3.14 CONNECTIONS TO EXISTING LINES
 - 3.14.1 Connections to Publicly or Privately Operated Gas Utility Lines
 - 3.14.2 Connection to Government Owned/Operated Gas Lines
- 3.15 TESTS
 - 3.15.1 Destructive Tests of Plastic Pipe Joints
 - 3.15.2 Pressure and Leak Tests
 - 3.15.2.1 Test Pressure
 - 3.15.2.2 Test Performance
 - 3.15.3 Meter Test
- 3.16 MAINTENANCE
 - 3.16.1 Gas Distribution System and Equipment Operation
 - 3.16.2 Gas Distribution System Maintenance
 - 3.16.3 Gas Distribution Equipment Maintenance

-- End of Section Table of Contents --

SECTION 33 51 15

NATURAL-GAS DISTRIBUTION PIPELINES

08/19

PART 1 GENERAL

1.1 SUMMARY

The gas distribution pipeline includes piping that conveys natural gas and all appurtenances from point of connection with existing system, to a point approximately 5 feet from the facility being served. The distribution pipeline, which must comply with 49 CFR 192, terminates at the isolation valve, service pressure regulator, or meter, whichever is the most downstream component before serving the facility gas piping. The facility gas piping that connects to this termination point is specified in Section 23 11 20 FACILITY GAS PIPING and must comply with NFPA 54.

Refer to Section 23 11 20, FACILITY GAS PIPING for natural gas piping requirements within the building.

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 B109.4	(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 XR0603	(2006; 8th Ed) AGA Plastic Pipe Manual for Gas Service

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L	(2018; 46th Ed; ERTA 2018) Line Pipe
API Spec 6D	(June 2018, 4th Ed; Errata 1 July 2018; Errata 2 August 2018) Specification for Pipeline and Piping Valves
API Std 1104	(2013; Errata 1-3 2014; Addendum 1 2014; Errata 4 2015; Addendum 2 2016) Welding of Pipeline and Related Facilities

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

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 B16.9	(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 B16.25	(2017) Buttwelding Ends
ASME B31.8	(2018; Supplement 2018) Gas Transmission and Distribution Piping Systems
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 PTC 25	(2014) Pressure Relief Devices

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A181/A181M	(2014; R 2020) Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A333/A333M	(2016) Standard Specification for Seamless and Welded Steel Pipe for Low-Temperature Service and Other Applications with Required Notch Toughness
ASTM D2513	(2018a) Standard Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
ASTM D2774	(2021) Underground Installation of Thermoplastic Pressure Piping
ASTM D3261	(2016) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D3308	(2012; R 2017) Standard Specification for PTFE Resin Skived Tape

ASTM D3350	(2021) Polyethylene Plastics Pipe and Fittings Materials
ASTM F1055	(2016a) Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
ASTM F1802	(2022) Standard Test Method for Performance Testing of Excess Flow Valves
ASTM F1948	(2015) Standard Specification for Metallic Fittings for Use on Outside Diameter Controlled Thermoplastic Gas Distribution Pipe and Tubing
ASTM F1973	(2013; R 2018) Standard Specification for Factory Assembled Anodeless Risers and Transition Fittings in Polyethylene (PE) and Polyamide 11 (PA11) and Polyamide 12 (PA12) Fuel Gas Distribution Systems
ASTM F2138	(2012; R 2017) Standard Specification for Excess Flow Valves for Natural Gas Service
ASTM F2164	(2018) Standard Practice for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure
ASTM F2620	(2020a; E 2021) Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
ASTM F2786	(2010) Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Gaseous Media Under Pressure (Pneumatic Leak Testing)
ASTM F2897	(2015a) Standard Specification for Tracking and Traceability Encoding System of Natural Gas Distribution Components (Pipe, Tubing, Fittings, Valves, and Appurtenances)

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-142	(2012) Excess Flow Valves for Fuel Gas Service, NPS 1 1/2 through 12

MASTER PAINTERS INSTITUTE (MPI)

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 119 (2016) Latex, Exterior, Gloss (MPI Gloss Level 6)

NACE INTERNATIONAL (NACE)

NACE SP0185 (2007) Extruded Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe

NACE SP0274 (1974; R 2011) High Voltage Electrical Inspection of Pipeline Coatings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2021) National Fuel Gas Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC 7/NACE No.4 (2007) Brush-Off Blast Cleaning

SSPC Paint 25 (1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

SSPC SP 1 (2015) Solvent Cleaning

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)

49 CFR 192 Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards

49 CFR 192.105 Design Formula for Steel Pipe

49 CFR 192.197 Control of the Pressure of Gas Delivered from High-Pressure Distribution 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 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

Pipe, Fittings, and Associated Materials

SD-03 Product Data

Materials and Equipment; G

Spare Parts; G

Pipe and Accessory Coatings; G

SD-05 Design Data

Connections to Existing Lines; G

Connection and Abandonment Plan; G

SD-06 Test Reports

Pressure and Leak Tests, AE

SD-07 Certificates

Welder's training and qualifications, AE

Jointing of Plastic Piping, AE

Utility Work, AE

SD-08 Manufacturer's Instructions

EFV Design and Installation Guide, AE

SD-10 Operation and Maintenance Data

Gas Distribution System and Equipment Operation; G

Gas Distribution System Maintenance; G

Gas Distribution Equipment Maintenance; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

1.4.1.1 Welding General

- a. Qualification of welding procedures and Welder's training and qualifications, including equipment used, detailed explanation of the procedure, and successfully making joints which pass tests must comply with Subpart E of 49 CFR 192.
- b. Submit procedures for welding of metallic piping that comply with API Std 1104 section 5, 12, or App. A; or ASME BPVC SEC IX. Quality of test welds used to qualify a procedure must be determined by destructive test. Submit the results of destructive testing of each procedure qualification for Government record.
- c. Submit a certificate of Welder's training and qualifications by test, requalification, or production work testing in conformance with

API Std 1104 section 6, 12, or App. A; ASME BPVC SEC IX; or as allowed per 49 CFR 192 Appendix C.

- d. Submit a list of names and identification symbols for all qualified welders and welding operators to be used on the project.
- e. Weld structural members in accordance with Section 05 12 00 STRUCTURAL STEEL.

1.4.1.2 Jointing of Plastic Piping

- a. Join piping by performance qualified plastic pipe joiners, qualified by a person who has been trained and certified by the manufacturer of the pipe, using manufacturer's pre-qualified joining procedures that have been tested in accordance with 49 CFR 192 Subpart F. Inspect joints by an inspector qualified in the joining procedures being used.
- b. Submit manufacturer's pre-qualified joining procedures and the results of testing performed to 49 CFR 192 Section 283.
- c. Plastic pipe joiners must be re-qualified at the beginning of each project by making specimen joints using the approve procedures and having those joints inspected by a qualified inspector and tested in accordance with 49 CFR 192 Section 285.
- d. Submit a certificate of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors. Notify the Contracting Officer at least 24 hours in advance of the date to qualify joiners and inspectors.

1.4.2 Pre-Installation Conference

1.4.2.1 Shop Drawings

Submit shop drawings, within 30 days of contract award, containing complete schematic and piping diagrams and any other details required to demonstrate that the system has been coordinated and functions properly as a unit. Show on the drawings proposed layout and anchorage of the system and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

1.4.2.2 Connecting and Abandonment Plan

Submit written notification of the method and schedule for making connections to existing gas lines, to the Contracting Officer at least 10 days in advance. Include gas line tie in, hot taps, abandonment/removal or demolition, purging, and plugging as applicable. ASME B31.8 may be used to help develop these plans, but the connection and abandonment must comply with 49 CFR 192. Include in submittal connections to existing lines, and if applicable connection and abandonment plan.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to the site for damage, and store with a minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping 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.

1.5.2 Handling

Handle pipe and components carefully to ensure a sound, undamaged condition. Take particular care not to damage pipe coating. Repair damaged coatings to original finish. Do not place pipe or material of any kind inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION. Handle coated steel piping in accordance with its listing and the manufacturer's written procedures. Handle plastic pipe in conformance with AGA XR0603.

1.6 EXTRA MATERIALS

Submit spare parts data for each different item of equipment and material specified, after approval of the detail shop drawings and not later than one month 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.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

Provide only materials that are allowed for natural gas by 49 CFR 192 for the specified distribution pipeline being installed.

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. Provide written verification and point of contact for a supporting service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Mark all valves, flanges, and fittings in accordance with MSS SP-25. Submit a complete list of materials and equipment, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions, including, but not limited to the following:

- a. Electrical Isolation Devices and Isolating Flange Kits.
- b. Fittings
- c. Piping
- d. Pipe and Accessory coatings
- e. Pressure Reducing Valves.
- f. Meters
- g. Regulators.
- h. Shut-off Valves
- i. Excess Flow Valve

2.1.1 Steel Pipe for Natural Gas Distribution

Provide steel piping that complies with API Spec 5L, Grade B, or X42; ASTM A53/A53M, Grade B; ASTM A106/A106M, Grade C; ASTM A333/A333M, Grade 3. Determine minimum pipe wall thickness as specified in 49 CFR 192.105 section "Design Formula for Steel Pipe" for the specific design conditions. Pipe wall thickness less than schedule 80 for pipes less than 2.5 inches diameter is not permitted.

2.1.2 Corrosion Protection for Steel Pipe for Underground Installation

2.1.2.1 External Coating Systems

Where steel pipe installation below ground is required by design of the gas carrier pipe, or as encasement for plastic pipe, provide pipe with a factory applied polyolefin resin coating system conforming to NACE SP0185, Type A. Pipe exterior must be cleaned to a commercial grade blast cleaning finish in accordance with SSPC SP 6/NACE No.3. Apply adhesive compound to the pipe with a nominal thickness of 10 mils (plus or minus 10 percent). Immediately after the adhesive is applied, extrude a seamless tube of polyolefin over the adhesive to produce a bonded seamless coating, with a nominal thickness of 40 mils (plus or minus 10 percent) of polyolefin resin for pipes up to 16 inches in diameter. For pipes 18 inches and larger in diameter, apply a minimum thickness of 60 mils (plus or minus 10 percent) polyolefin resin.

Do not coat pipe and fittings for aboveground lines.

2.1.3 Steel and Malleable Iron Fittings, 1-1/2 inches and Smaller

Provide steel butt-weld fittings conforming to ASME B16.9 or threaded malleable iron fittings for natural gas pipe conforming to ASME B16.11.

2.1.4 Steel Fittings, 2 inches and Larger

Provide weld neck pipe flanges and flanged fittings, including bolts, nuts, and bolt patterns in accordance with ASME B16.5, Class . Provide butt-weld fittings in accordance with ASME B16.9.

2.1.5 Steel Forged Branch Connections

Provide steel forged branch connections conforming to ASTM A181/A181M, Class 60, carbon steel.

2.1.6 Flange Gaskets

Provide gaskets for natural gas systems that are non-asbestos compressed material gaskets in accordance with ASME B16.21, 1/16 inch minimum thickness, full face or self-centering flat ring type, containing aramid fibers bonded with nitrile butadiene rubber (NBR), or glass fibers bonded with polytetrafluoroethylene, suitable for maximum 600 degrees F service.

2.1.7 Pipe Threads

Provide pipe threads for natural gas piping conforming to ASME B1.20.1.

2.1.8 Sealants for Steel Pipe Threaded Joints in Natural Gas Systems

2.1.8.1 Sealing Compound

Provide joint sealing compound as listed in UL FLAMMABLE & COMBUSTIBLE, Class 20 or less that is qualified for use with natural gas .

2.1.8.2 Tape

Provide polytetrafluoroethylene tape conforming to ASTM D3308 that is qualified for use with natural gas.

2.2 PLASTIC PIPE, TUBING, FITTINGS AND JOINTS

2.2.1 Polyethylene Gas Pressure Pipe, Tubing, and Fittings

Provide polyethylene (PE) pipe, tubing, fittings conforming to ASTM D2513, as specified in 49 CFR 192 Appendix B and manufactured using material that complies with ASTM D3350. Pipe wall thickness must comply with the Standard Dimension Ratio, SDR-11, or lower value, meaning thicker wall. The Hydrostatic Design Basis (HDB) of the selected PE material must exceed the Maximum Allowable Operating Pressure (MAOP), at the anticipated operating temperature of the system in which it is installed. Mark pipe, tubing, and fittings as required by ASTM D2513 and with traceability code per ASTM F2897.

Provide polyethylene fittings that are constructed of polyethylene of the same material classification and SDR as the connecting pipe, and comply with ASTM D2513. Provide fittings with butt-type fusion fittings complying with ASTM D3261.

Where mechanical fittings are specified on the engineering drawings, provide mechanical fittings that comply with ASTM F1948 and are category 1 for pressure integrity, gas tightness, and provide pull-out resistance equivalent to the pipe strength.

Provide heat fusion joints complying with ASTM F2620 and the manufacturer's written procedure approved by the contracting officer. Electro fusion joints fittings must comply with ASTM F1055 and the manufacturer's written procedure approved by the contracting officer. Perform underground installations in conformance with ASTM D2774.

2.2.2 Mechanical Fittings for use with Plastic Pipe

Use of mechanical fittings in distribution pipelines constructed of plastic requires the approval of Engineering and the Contracting Officer. Mechanical fittings may be approved only where other methods of connecting piping and appurtenances will produce a less reliable gas tight connection.

Mechanical fittings, their use, and installation must comply with 49 CFR 192. Mechanical fittings must meet the requirements of category 1 presented in ASTM F1948 for metallic mechanical fittings to remain gas tight while resisting pull-out forces.

Mechanical fittings constructed of metal or plastic other than the plastic specified for piping must be approved based on submission of manufacturer's test data and historical service records indicating their acceptability for the intended service.

Submit all traceability information for each mechanical fitting to include, but not limited to, the manufacturer, part number, serial number, and geographic information system coordinates of the installed location.

2.3 VALVES

2.3.1 Carbon Steel Valves for Natural Gas Pipelines

Provide valves suitable for shutoff or isolation in natural gas pipelines conforming to the requirements of 49 CFR 192. All materials used in valve

construction must be resistant to the action of the gas being distributed under the service conditions.

Provide carbon steel valves installed in natural gas pipelines that comply with API Spec 6D. Provide ball, check, gate, and plug valves as specified in the design drawings.

Provide Class 150 steel valves 1-1/2 inches and smaller installed underground with butt-weld ends complying with ASME B16.25, with square wrench operator adaptor and corrosion prevention.

Provide Class 150 steel valves 1-1/2 inches and smaller installed aboveground with butt-weld complying with ASME B16.25 or threaded ends complying with ASME B1.20.1, with hand wheel or wrench operator.

Provide Class 150 steel valves 2 inches and larger installed underground with butt-weld ends complying with ASME B16.25, and square wrench operator adaptor and corrosion prevention coating.

Provide Class 150 steel valves 2 inches and larger installed aboveground with butt-weld complying with ASME B16.25 or flanged ends complying with ASME B16.5, with hand wheel or wrench operator.

Provide valves 8 inches and larger with worm or spur gear operators, totally enclosed, grease packed, and sealed, with operators having Open and Closed stops and position indicators. Provide locking feature where indicated. Wherever the lubricant connections are not conveniently accessible, provide extensions for the application of lubricant. Provide valves with lubricant compatible with gas service.

2.3.2 Excess Flow Valve (EFV)

Provide bypass type EFV with automatic reset that conforms to MSS SP-142 and ASTM F2138 and tested to ASTM F1802. Submit an EFV Design and Installation Guide which includes the manufacturer's product design data and installation instructions. Submit all traceability information for each EFV to include, but not limited to, the manufacturer, part number, serial number, and geographic information system coordinates of the installed location. Provide appropriate valve box where access for maintenance or reset is required.

2.3.3 Valve Box

Provide rectangular concrete valve box, sized large enough for removal of valve without removing box. Cast the word "Gas" into the box cover. Use valve box for areas as follows:

- a. Roads and Traffic Areas: Heavy duty, cast iron cover.
- b. Other Areas: Standard duty, concrete cover.

2.4 PRESSURE REGULATORS

Provide ferrous bodied regulators with backflow protection, designed to meet the pressure, temperature, flow and other service conditions.

2.4.1 Natural Gas Main Regulators

Provide pressure regulators for main gas distribution pipelines from a

qualified manufacture of pipeline regulators. Equip distribution pipelines with regulators where that pipeline is supplied from a source of gas that is at higher pressure than the maximum allowable operating pressure of the distribution pipeline. Provide regulators of adequate capacity that are rated for the inlet pressure of the gas source and the anticipated operating temperature. In addition to the pressure regulating devices, provide a protective method to prevent overpressuring of the system in accordance with 49 CFR 192, Section 195. Suitable protective devices are as follows:

- a. Spring-loaded relief valve meeting the provisions of ASME BPVC SEC VIII D1.
- b. Pilot-loaded back pressure regulator used as relief valve, so designed that failure of the pilot system causes the regulator to open.
- c. Weight-loaded relief valves conforming to ASME PTC 25.
- d. Monitoring relief valves conforming to ASME PTC 25.
- e. Series regulator installed upstream from the primary regulator, set to limit the pressure on the inlet of the primary regulator continuously to the maximum allowable operating pressure of the system, or less.
- f. Automatic shutoff device installed in series with the primary regulator, set to shut off when the pressure on the distribution system reaches the maximum allowable operating pressure of the system, or less, which remains closed until manually reset.
- g. Spring-loaded, diaphragm type relief valves.

2.4.2 NaturalService Regulators

Provide ferrous bodied service regulators conforming to AGA ANSI B109.4 with full capacity internal relief and downstream automatic overpressure shut-off.

Service regulators must meet each of the following requirements.

- a. Capable of reducing distribution line pressure to the safe pressure required by the connected equipment.
- b. Capable of limiting, under no flow conditions, the build-up of downstream pressure that would cause unsafe operation of the connected equipment.
- c. Pipe connections of 2 inches or less.
- d. Single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet.
- e. Valve seat of resilient materials designed to withstand flow conditions when pressed against the valve port.
- f. Self-contained with no external static or control lines.

Set pressure relief at a lower pressure than would cause unsafe operation of any connected and properly adjusted gas utilization equipment.

2.4.3 Overpressure Protection for Service Lines, Operating Pressure Greater than 60 psig, but Less than 125 psig

Where the gas distribution system is operated at a pressure greater than 60 psig, but less than 125 psig, provide one of the following methods of overpressure protection for the service regulator and facility gas piping system:

- a. Additional upstream regulator plus pressure relief or automatic shut-off.
- b. Additional upstream monitoring regulator that, in the event of service regulator failure, prevents the pressure of gas supplied to the customer from exceeding a maximum safe value.
- c. A service regulator with internal relief or downstream relief valve.
- d. An automatic shut-off device with manual reset.

2.4.4 Overpressure Protection for Service Lines, Operating Pressure Greater than 125 psig

In addition to the required service regulator, provide an additional upstream regulator that is set to maintain the inlet pressure to the service regulator to 60 psig or less .

2.5 METERS

Refer to Section 23 11 20, FACILITY GAS PIPING for natural gas meter.

2.6 TELEMETERING OR RECORDING GAUGES

Equip each distribution system supplied by more than one district pressure regulating station with telemetering or recording pressure gauges to indicate the gas pressure in the district line.

2.7 GAS TRANSITION FITTINGS

Provide manufactured steel-to-plastic gas transition fittings approved for jointing steel and polyethylene pipe, conforming to ASTM F1973 requirements for transition fittings.

Provide anodeless riser on service lines to transition from below grade plastic piping to above grade steel piping in accordance with 49 CFR 192. Polyethylene-to-steel anodeless risers must comply with ASTM F1973 and ASTM D2513 - Category 1 specifications for gas tight seal and pull-out resistance. Protect steel pipe from corrosion by a factory applied coating.

2.8 IDENTIFICATION

Provide pipe flow markings and metal tags for each valve, meter, and regulator as required by the Contracting Officer.

2.9 ELECTRICALLY ISOLATED JOINT MATERIALS

Provide insulating joint materials between flanged or threaded metallic pipe systems to electrically isolate piping that is protected by cathodic protection systems. Devices must comply with NACE requirements.

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 EXCAVATION AND BACKFILLING

Provide earthwork as specified in Section 31 00 00 EARTHWORK.

3.3 GAS MAINS

Provide steel pipe for aboveground installation. Provide polyethylene pipe for underground service..

3.4 SERVICE LINES

Construct service lines of materials specified for gas mains and extend from a gas main to and including the point of delivery within 5 feet of the building. The point of delivery is the meter set assembly, service regulator and shutoff valve. Connect the service lines to the gas mains through service tees, with end of run plugged.

Where indicated, provide service line with an isolation valve of the same size as the service line, located in a valve box. Make the service lines as short and as straight as practicable between the point of delivery and the gas main, without bends or lateral curves unless necessary to avoid obstructions or otherwise permitted. Lay service lines with as few joints as practicable using standard lengths of pipe, use shorter lengths only for closures. Do not install polyethylene service lines aboveground.

3.5 WORKMANSHIP AND DEFECTS

Ensure pipe, tubing, and fittings are clear and free of cutting burrs and defects in structure or threading, and thoroughly brushed and blown free of chips and scale. Do not repair, but replace defective pipe, tubing, or fittings.

3.6 PROTECTIVE COATING

3.6.1 Protective Coating for Underground Steel Pipe

Where steel pipe is installed below grade for either the gas carrier pipe or as a casing for plastic carrier pipe, protect this pipe from corrosion by an extruded polyolefin resin coating system over a soft adhesive applied to the steel pipe. This coating must be either factory applied or applied using a field plant especially equipped for the purpose. Hand apply protective covering to valves and fittings that cannot be coated and wrapped mechanically, preferably at the plant that applies the covering to the pipe. Coat and wrap joints by hand, in a manner and with materials that produce a covering equal in thickness to that of the covering applied mechanically.

3.6.1.1 Field Plant Applied Polyolefin Resin Coating System

Provide a polyolefin resin coating system conforming to NACE SP0185, Type A. Clean the exterior of the pipe to a commercial grade blast cleaning finish in accordance with SSPC SP 6/NACE No.3, and apply adhesive compound to the pipe with a nominal thickness of 10 mils (plus or minus 10 percent). Immediately after the adhesive is applied, extrude a seamless tube of polyolefin over the adhesive to produce a bonded seamless coating, with a nominal thickness of 40 mils (plus or minus 10 percent) of polyolefin resin for pipes up to 16 inches in diameter. For pipes 18 inches and larger in diameter, apply a minimum thickness of 60 mils (plus or minus 10 percent) polyolefin resin.

3.6.1.2 Pipe Joint and Field Repair Coating System

Apply joint coating and field repair material as recommended by the coating manufacturer, consisting of one the following:

- a. Heat shrinkable polyethylene sleeves.
- b. High density polyethylene/bituminous rubber compound tape.

Inspect the coating system for holes, voids, cracks, and other damage during installation.

3.6.1.3 Inspection of Pipe Coatings

Repair any damage to the protective covering during transit and handling before installation. After field coating and wrapping has been applied, inspect the entire pipe using an electric holiday detector with impressed current set at a value in accordance with NACE SP0274 using a full-ring, spring-type coil electrode. Equip the holiday detector with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. Immediately repair all holidays in the protective covering upon detection. The Contracting Officer reserves the right to inspect and determine the suitability of the detector. Furnish labor, materials, and equipment necessary for conducting the inspection.

3.6.2 Protective Covering for Aboveground Piping Systems

Apply finish painting conforming to the applicable paragraphs of Section 09 90 00 PAINTS AND COATINGS and as follows:

3.6.2.1 Ferrous Surfaces

Touch up shop primed surfaces with ferrous metal primer of the same type paint as the shop primer. Solvent-clean surfaces that have not been shop primed in accordance with SSPC SP 1. Mechanically clean surfaces that contain loose rust, loose mill scale, and other foreign substances by power wire brushing in accordance with SSPC SP 3 or brush-off blast clean in accordance with SSPC 7/NACE No.4 and primed with ferrous metal primer in accordance with SSPC Paint 25. Finish primed surfaces with two coats of exterior alkyd paint conforming to MPI 9.

3.6.2.2 Nonferrous Surfaces

Do not paint nonferrous surfaces. Paint nonferrous surfaces to protect from the exposed corrosive conditions. Solvent-clean the surfaces in accordance with SSPC SP 1. Apply a first coat of MPI 10, and 2 coats of

MPI 119 or MPI 11.

3.6.3 Protective Covering for Piping in Valve Boxes and Manholes

Apply protective coating to piping in valve boxes or manholes as specified for underground steel pipe.

3.7 INSTALLATION

Install gas distribution system and equipment in conformance with the manufacturer's recommendations and applicable sections of 49 CFR 192.

3.7.1 Abandonment of Natural Gas Distribution Pipelines

Perform abandonment of existing gas piping in accordance with ASME B31.8, the contract drawing details and the requirements of 49 CFR 192, Section 727. Purge natural gas piping so that there is no potential hazard. Provide locking devices for the shut-off valve located at the end of the service line supplying gas to a discontinued customer. Cut the pipe without damaging the pipe. Unless otherwise authorized, use an approved type of mechanical cutter. Use wheel cutters where practicable. On steel pipe 6 inches and larger, an approved gas-cutting-and-beveling machine may be used. Cut plastic pipe in accordance with AGA XR0603. Fill abandoned vaults with suitable compacting material. Record and submit to the COR the Geographic Information System (GIS) location of any abandoned distribution pipeline that crosses over, under, or through a navigable waterway.

3.7.2 Installing Pipe Underground

Grade gas mains and service lines as indicated. Grade service lines so as to drain back to the main or into drips as indicated. Weld joints in steel pipe except as otherwise permitted for installation of valves. Provide mains with 24 inch minimum cover; service lines with 18 inch minimum cover; and place both mains and service lines on firmly compacted select material for the full length.

Where indicated, encase, bridge, or design the main to withstand any anticipated external loads as specified in 49 CFR 192. Provide standard weight black steel pipe encasement material with a protective coating as specified. Separate the pipe from the casing by insulating spacers and seal the ends with casing bushings. Excavate the trench below pipe grade, bed with bank sand, and compact to provide full-length bearing. Laying pipe on blocks to produce uniform grade is not permitted. Ensure that the pipe is clean inside before it is lowered into the trench and keep free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves, regulators, meters, or other equipment. When work is not in progress, securely close open ends of pipe or fittings with expandable plugs or other suitable means. Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved.

Make changes in line or gradient that exceed the limitations specified with fittings. When cathodic protection is furnished, provide electrically insulated joints or flanges.

When polyethylene piping is installed underground and not encased in a metallic casing, place a tracer wire or other electrically conductive

element above the pipe in accordance with 49 CFR 192 to permit locating with underground detection devices. After laying of pipe and testing, backfill the trench in accordance with Section 31 00 00 EARTHWORK, and in a manner provides firm support under the pipe and prevents damage to the pipe and pipe coating from equipment or from the backfill material.

3.7.3 Installing Pipe Aboveground

Protect aboveground piping against dirt and other foreign matter, as specified for underground piping. Weld joints in steel pipe; however, joints in pipe 1-1/2 inches in diameter and smaller may be threaded; joints may also be threaded to accommodate the installation of valves. Provide flanges of the weld neck type to match wall thickness of pipe.

3.8 PIPE JOINTS

Provide pipe joints complying with the requirements of 49 CFR 192, Subpart E for welding of steel pipelines and Subpart F for joints other than welding. Design and install pipe joints to effectively sustain the longitudinal pullout forces and thrust forces caused by the contraction and expansion of piping or superimposed loads. Make each joint in accordance with the submitted and approved written joining procedure that has been proven to produce strong, gas-tight joints. Each joint must be inspected by the approved inspector.

3.8.1 Threaded Steel Joints

Provide threaded joints in steel pipe with tapered threads evenly cut, made with UL approved joint sealing compound approved for gas service or polytetrafluoroethylene tape approved for gas service applied to the male threads only. Caulking of threaded joints to stop or prevent leaks is not permitted.

3.8.2 Welded Steel Joints

Perform gas pipe weldments, as indicated, in accordance with the submitted and approved welding procedures, and by the approved qualified welders. Make changes in direction of piping by welding 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 welding tees or forged branch outlet fittings. Use forged or flared branch outlet fittings for improvement of flow where attached to the run, and reinforced against external strains. Perform all beveling, alignment, heat treatment, and inspection of welds conforming to API Std 1104 and the ASME Boiler and Pressure Vessel Code. Remove weld defects and repair the weld, or remove the weld joints entirely and reweld. After filler metal has been removed from its original package, protect it or 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..

3.8.3 Plastic Pipe Jointing Procedures

Use jointing procedures that have been submitted and approved for this project. Joints in plastic pipe must be made by the qualified personnel submitted and approved for this project, who have the requalification requirements of 49 CFR 192, Section 285. Each joint made must be inspected by the qualified inspector that was submitted and approved for this project.

Heat fusion joining of plastic pipe or fittings made from different plastic resins by classification or by manufacturer are not allowed. If heat fusion joining of similar polyethylene resin classification is required in pipe made by different manufacturers, the procedure must be qualified by test in accordance with 49 CFR 192, Section 283 requirements and AGA XR0603. The personnel making these joints must be qualified using this procedure in accordance with 49 CFR 192, Section 285 requirements. Submit all data: written procedure, test specimens, test results, inspection reports, etc. to show complete jointing qualification per 49 CFR 192 requirements to the COR.

Where joining procedures for plastic pipes by heat fusion cannot be properly qualified, an alternative connection method must be used.

3.8.4 Mechanical Couplings for Plastic Pipe Jointing

Make mechanical joints in accordance with the procedures that have been qualified in accordance with 49 CFR 192, Section 283(b). Submit evidence that the five specimen joints configured and tested in accordance with 283(b)(1), (2) and (3) failed in a manner consistent with 283(b)(4), (5) and (6) as applicable. For the mechanical coupling, obtain the manufacturer's model number, serial number, and date of manufacture, record the date of installation and obtain the Geographical Information System (GIS) location of the installed mechanical coupling. Submit to the COR, this and all other data required by 49 CFR 192 to be submitted to the Pipeline and Hazardous Material Safety Administration (PHMSA).

3.8.5 Connections Between Metallic and Plastic Piping

Only make metallic to plastic connections outside, underground, and with approved transition fittings.

3.9 VALVES

Install valves in locations shown on the drawings and at locations required by 49 CFR 192. Design valve installation in plastic pipe to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box.

For systems where the maximum distribution pressure exceeds 60 psig operating pressure, provide a method to regulate and limit the pressure of the gas in the system that complies with 49 CFR 192.197 paragraphs (c)(1) through (4).

3.10 VALVE BOXES

Provide valve boxes of cast iron not less than 3/16 inch thick at each underground valve except where concrete or other type of housing is indicated. Provide valve boxes with locking covers that require a special wrench for removal, and furnish the correctly marked wrench for each box. Cast the word "GAS" in the box cover. When the valve is located in a roadway, protect the valve box by a suitable concrete slab at least 3 square feet and install an access cover that is traffic rate cast iron of ample thickness to support expected traffic loads. When in a sidewalk, provide the top of the box as a removable concrete slab 2 feet square and set flush with the sidewalk. Make the boxes adjustable extension type with screw or slide-type adjustments. Separately support valve boxes to not rest on the pipe, so that no traffic loads can be transmitted to the

pipe. Only locate valves in valve boxes or inside of buildings.

3.11 DRIPS

Install drips conforming to the details, provide commercial units of approved type and capacity. Connect a blow off pipe 1-1/4 inches or larger to each drip at its lowest point and extend to or near the ground surface at a convenient location away from traffic. Provide a reducing fitting for each discharge at each drip terminal (outlet), a plug valve, and a 1/2 inch nipple turned down. Locate the discharge terminal (outlet) inside a length of 12 inches or larger vitrified clay pipe, concrete sewer pipe or concrete terminal box set vertically on a bed of coarse gravel 1 foot thick and 3 feet square, with concrete bottom to contain liquids and a connection to remove liquids for disposal, and closed at the ground surface with a suitable replacement cover.

3.12 PRESSURE REGULATOR INSTALLATION

3.12.1 Main Distribution Line Regulators

Install pressure regulators. Install a valve on each side of the regulator for isolating the regulator for maintenance. Provide a bypass line with bypass valves or 3 way valves and an over-pressurization pressure regulating device. Install regulators and valves in rectangular reinforced concrete boxes, large enough so that all required equipment can be properly installed, operated, and maintained, with box sidewalls extending above ground line. Provide the boxes with cast iron manhole covers with locking provisions and 4 inch diameter vents. Furnish one key or other unlocking device with each cover. Locate discharge stacks, vents, or outlet ports of all pressure relief devices where gas can be discharged into the atmosphere without undue hazard. Provide stacks and vents with fittings to preclude entry of water.

3.12.2 Service Line Regulators

Install a shutoff valve, meter set assembly, and service regulator on the service line outside the building, 18 inches above the ground on the riser. Where steel service lines are used, install an insulating joint on the inlet side of the meter set assembly and service regulator and construct to prevent flow of electrical current. Provide a 3/8 inch tapped fitting equipped with a plug on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. 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.

3.13 METER INSTALLATION

Provide service entrance piping up to natural gas meter, also provided by natural gas utility, located outside building. Provide meters in accordance with 49 CFR 192. Install permanent gas meters with provisions for isolation and removal for calibration and maintenance, and suitable for operation in conjunction with an energy monitoring and control system. Connect meter complying with the requirements of the Advanced Metering Program that is applied at the particular Government Installation of this project.

3.14 CONNECTIONS TO EXISTING LINES

Make connections between new work and existing gas lines, where required, in accordance with 49 CFR 192, using proper fittings to suit the actual conditions. When connections are made by tapping into a gas main, provide the same size connecting fittings as the pipe being connected.

3.14.1 Connections to Publicly or Privately Operated Gas Utility Lines

Provide materials for the connections to the existing gas lines. The Utility is to make final connections and turn on the gas. The Utility is to also disconnect, purge and cap, plug or otherwise effectively seal existing lines that are to be abandoned or taken out of service. Notify the Contracting Officer, in writing, 10 days before final connections and turning on of gas lines. Make necessary arrangements with the Utility for tie in and activation of new gas lines. Only the Operating Agency/Utility Company may reactivate the system after tie in. Furnish a certification by the Operating Agency/Utility Company that all Utility work has been satisfactorily completed.

3.14.2 Connection to Government Owned/Operated Gas Lines

Provide connections to the existing gas lines in accordance with approved procedures. Only perform deactivation of any portion of the existing system at the valve location indicated. Reactivation of any existing gas lines will only be done by the local Utility. Submit the approved Connection and Abandonment Plan that is compliant with the requirements of 49 CFR 192, Section 727 prior to making any connections to existing gas lines, manure the Utility's required procedures which may be obtained from the government.. Notify the Contracting Officer, in writing, 10 days before connections to existing lines are to be made.

For each pipeline that is to be abandoned in place, submit the approved Connection and Abandonment Plan that is compliant with the requirements of 49 CFR 192, Section 727. Ensure the following steps are taken at a minimum:

- a. For each pipeline that is to be abandoned in place, physically disconnect that from all sources of gas. Purge, cap, plug or otherwise effectively seal the open ends of all abandoned pipelines. Do not complete abandonment until it has been determined that the volume of gas or condensed hydrocarbons contained within the abandoned section poses no potential hazard. Use air or inert gas for purging, or fill the facility with water or other inert material. If air is used for purging, ensure that a combustible mixture is not present after purging.
- b. When a main is abandoned, together with the service lines connected to it, seal the disconnected end of the main and seal the customer's end of each service line as stipulated above.
- c. Where service lines are to be abandoned in place, disconnect the abandoned service lines from the active mains as close to the main as practicable. 49 CFR 192 does not require individual service lines to be sealed.
- d. Close all valves left in the abandoned segment.
- e. Remove all above grade valves, risers, and vault and valve box

covers. Fill vault and valve box voids with suitable compacted backfill material.

3.15 TESTS

3.15.1 Destructive Tests of Plastic Pipe Joints

Prior to making heat fusion joints in plastic pipelines, make a joint of each size and type to be installed that day by each person performing joining of plastic pipe that day and destructively test. Make the specimen joint per the approved written procedure. Cut at least 3 longitudinal straps from each joint. Visually examine each strap for voids or discontinuities on the cut surfaces of the joint area. Deform each of the 3 straps by bending, torque, or impact. Failures are not permitted in the joint area. If a joint fails the visual or deformation test, the qualified joiner who made that joint is not allowed to make further field joints in plastic pipe on this job until that joiner has been retrained and re-qualified. Record and submit the results of the destructive tests including the date and time of the tests, size and type of the joints, ambient conditions, fusion iron temperature and names of inspectors and joiners.

3.15.2 Pressure and Leak Tests

Test the system of gas mains and service lines after construction and before being placed in service, using a test pressure and test medium approved in 49 CFR 192 Subpart J for the applicable conditions of construction. In the event of conflict between the contract test pressure and medium and the test requirements of 49 CFR 192, refer conflict to the COR before continuing with testing. Follow all testing recommendations and safety precautions as recommended by the piping manufacturer's specifications and 49 CFR 192. Follow a written test procedure that ensures all potentially hazardous leaks are discovered. Submit data in booklet form from all pressure tests of the distribution system.

3.15.2.1 Test Pressure

Test each segment of the installed pipeline at the test pressure listed below for the applicable installation:

- a. Strength test steel pipelines operated at a pressure that creates a hoop stress of 30% or more of the Specified Minimum Yield Strength (SMYS), in accordance with 49 CFR 192, Section 505, by hydrostatic testing at a minimum of 125 percent the Maximum Allowable Operating Pressure (MAOP). Maintain strength test pressure for a minimum of 8 hours.
- b. For metallic mains operated at or above 100 psig that produces a hoop stress less than 30 percent SMYS, leak test in accordance with 49 CFR 192, Section 507, by pneumatic or hydrostatic testing at a pressure between 100 psig and the pressure required to produce a hoop stress of 20 percent of the SMYS. Maintain test pressure for a minimum of 24 hours.
- c. For metallic mains operated below 100 psig, leak test in accordance with 49 CFR 192, Section 509. Leak test mains operated below 1 psig to a pressure not less than 10 psig. Leak test mains operated at or above 1 psig to a pressure not less than 90 psig. Maintain test pressure for a minimum of 24 hours.

- d. For metallic service lines, leak test in accordance with 49 CFR 192, Section 511. Leak test service lines operated at 40 psig or less to a pressure not less than 50 psig. Leak test service lines operated above 40 psig to a pressure of 90 psig. Ensure that the service line connection to the main is included in this test. Maintain test pressure for a minimum of 24 hours.
- e. For plastic mains and service lines, leak test in accordance with 49 CFR 192, Section 513. Leak test to a pressure at least 150% of the Maximum Allowable Operating Pressure (MAOP) or 50 psig, whichever is greater. Where a compressible gas is used as the test medium, perform pneumatic leak testing of polyethylene (PE) piping in accordance with ASTM F2786 observing the determination of Maximum Test Pressure, which is calculated using the PE material hydrostatic design stress, the pipe temperature reduction factor and the leak test duration factor. Submit a test procedure that identifies the MAOP of the pipeline, the temperature dependent maximum test pressure, and a step by step procedure for increasing the pipeline pressure as detailed in ASTM F2786 for pneumatic testing or ASTM F2164 for hydrostatic testing. From the beginning of pipeline pressurization to the depressurization of the pipeline the time duration must not exceed 8 hours. If testing must be restarted after maximum test pressure has been reached, depressurize the pipeline for a minimum of 8 hours before restart of pipeline pressurization.

3.15.2.2 Test Performance

Perform testing as follows:

- a. Prior to testing the system, blow-out, clean, and clear the interior of all foreign materials. Remove all meters, regulators, and controls before blowing out and cleaning, and reinstall after clearing of all foreign materials.
- b. Perform testing of gas mains and service lines with due regard for the safety of employees and the public during the test. Keep persons not working on the test operations out of the testing area during testing. Perform the test on the system as a whole or on sections that can be isolated.
- c. Test joints in sections prior to backfilling when trenches are to be backfilled before the completion of other pipeline sections. Continue the test for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. Do not take the initial test readings of the instrument for at least 1 hour after the pipe has been subjected to the full test pressure. Do not take initial or final readings at times of rapid changes in atmospheric conditions, and temperatures are representative of the actual trench conditions. No indication of reduction of pressure is allowed during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship $T(1)P(2)=T(2)P(1)$, in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings.
- d. During the test, completely isolate the the entire system from all compressors and other sources of air pressure. Test each joint by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. Secure approval of testing

instruments from the Contracting Officer. Furnish all labor, materials and equipment for conducting the tests subject to inspection at all times during the tests. Maintain safety precautions for air pressure testing at all times during the tests.

3.15.3 Meter Test

Test meter to verify data transfer to data collection server and validate calibration of both meter and the data that is received by the data collection server.

3.16 MAINTENANCE

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, in three separate packages. Submit Data packages, as specified.

3.16.1 Gas Distribution System and Equipment Operation

Include maps showing piping layout, locations of system valves, gas line markers and cathodic protection system test stations; step-by-step procedures for system start up, operation and shutdown (index system components and equipment to the system maps); 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 per Section 01 78 23.

3.16.2 Gas Distribution 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 per Section 01 78 23.

3.16.3 Gas Distribution Equipment Maintenance

Include identification of valves 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 per Section 01 78 23.

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 71 02

UNDERGROUND ELECTRICAL DISTRIBUTION

08/21

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 DEFINITIONS
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Precast Underground Structures
 - 1.4.2 Standard Products
 - 1.4.2.1 Alternative Qualifications
 - 1.4.2.2 Material and Equipment Manufacturing Date

PART 2 PRODUCTS

- 2.1 CONDUIT, DUCTS, AND FITTINGS
 - 2.1.1 Rigid Metal Conduit
 - 2.1.1.1 Rigid Metallic Conduit, PVC Coated
 - 2.1.2 Intermediate Metal Conduit
 - 2.1.2.1 Intermediate Metal Conduit, PVC Coated
 - 2.1.3 Plastic Duct for Concrete Encasement
 - 2.1.4 Duct Sealant
 - 2.1.5 Fittings
 - 2.1.5.1 Metal Fittings
 - 2.1.5.2 PVC Conduit Fittings
 - 2.1.5.3 PVC Duct Fittings
- 2.2 LOW VOLTAGE INSULATED CONDUCTORS AND CABLES
 - 2.2.1 Conductor Types
 - 2.2.2 Conductor Material
 - 2.2.3 Cable Marking
- 2.3 LOW VOLTAGE WIRE CONNECTORS AND TERMINALS
- 2.4 LOW VOLTAGE SPLICES
 - 2.4.1 Heat Shrinkable Splice
 - 2.4.2 Cold Shrink Rubber Splice
- 2.5 MEDIUM VOLTAGE CABLE
 - 2.5.1 Cable Configuration
 - 2.5.2 Conductor Material
 - 2.5.3 Insulation
 - 2.5.4 Shielding
 - 2.5.5 Jackets
- 2.6 TELECOMMUNICATIONS CABLING
- 2.7 PULL ROPE
- 2.8 GROUNDING AND BONDING
 - 2.8.1 Driven Ground Rods
 - 2.8.2 Grounding Conductors
- 2.9 CAST-IN-PLACE CONCRETE
- 2.10 UNDERGROUND STRUCTURES
 - 2.10.1 Cast-In-Place Concrete Structures

- 2.10.2 Precast Concrete Structures, Risers and Tops
 - 2.10.2.1 General
 - 2.10.2.2 Design for Precast Structures
 - 2.10.2.3 Construction
 - 2.10.2.4 Joints
- 2.10.3 Manhole Frames and Covers
- 2.10.4 Handhole Frames and Covers
- 2.10.5 Composite/Fiberglass Handholes and Covers
- 2.11 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)
 - 2.11.1 Cable Rack Stanchions
 - 2.11.2 Rack Arms
 - 2.11.3 Insulators
- 2.12 CABLE TAGS IN MANHOLES
 - 2.12.1 Polyethylene Cable Tags

PART 3 EXECUTION

- 3.1 INSTALLATION
- 3.2 CABLE INSPECTION
- 3.3 UNDERGROUND FEEDERS SUPPLYING BUILDINGS
- 3.4 UNDERGROUND STRUCTURE CONSTRUCTION
 - 3.4.1 Cast-In-Place Concrete Structures
 - 3.4.2 Precast Concrete Construction
 - 3.4.3 Pulling-In Irons
 - 3.4.4 Cable Racks, Arms and Insulators
 - 3.4.5 Field Painting
- 3.5 UNDERGROUND CONDUIT AND DUCT SYSTEMS
 - 3.5.1 Requirements
 - 3.5.2 Treatment
 - 3.5.3 Conduit Cleaning
 - 3.5.4 Jacking and Drilling Under Roads and Structures
 - 3.5.5 Multiple Conduits
 - 3.5.6 Conduit Plugs and Pull Rope
 - 3.5.7 Conduit and Duct Without Concrete Encasement
 - 3.5.7.1 Encasement Under Roads and Structures
 - 3.5.8 Duct Encased in Concrete
 - 3.5.8.1 Connections to Manholes
 - 3.5.8.2 Connections to Existing Underground Structures
 - 3.5.8.3 Connections to Existing Concrete Pads
 - 3.5.8.4 Partially Completed Duct Banks
 - 3.5.9 Duct Sealing
- 3.6 CABLE PULLING
 - 3.6.1 Cable Lubricants
- 3.7 CABLES IN UNDERGROUND STRUCTURES
 - 3.7.1 Cable Tag Installation
- 3.8 CONDUCTORS INSTALLED IN PARALLEL
- 3.9 LOW VOLTAGE CABLE SPLICING AND TERMINATING
- 3.10 GROUNDING SYSTEMS
 - 3.10.1 Grounding Electrodes
 - 3.10.2 Grounding Connections
 - 3.10.3 Grounding Conductors
 - 3.10.4 Ground Cable Crossing Expansion Joints
 - 3.10.5 Manhole Grounding
- 3.11 EXCAVATING, BACKFILLING, AND COMPACTING
 - 3.11.1 Reconditioning of Surfaces
 - 3.11.1.1 Unpaved Surfaces
 - 3.11.1.2 Paving Repairs
- 3.12 CAST-IN-PLACE CONCRETE
 - 3.12.1 Concrete Slabs (Pads) for Equipment

3.13 FIELD QUALITY CONTROL

3.13.1 Performance of Field Acceptance Checks and Tests

3.13.1.1 Low Voltage Cables, 600-Volt

3.13.1.2 Grounding System

3.13.2 Follow-Up Verification

-- End of Section Table of Contents --

SECTION 33 71 02

UNDERGROUND ELECTRICAL DISTRIBUTION

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 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

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 B496 (2016) Standard Specification for Compact Round Concentric-Lay-Stranded Copper Conductors

ASTM C309 (2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C478 (2018) Standard Specification for Circular Precast Reinforced Concrete Manhole Sections

ASTM C857 (2016) Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures

ASTM C990 (2009; R 2014) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants

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 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

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 9 (2020) Standard for Fittings for Polyvinyl Chloride (PVC) Plastic Utilities Duct for Underground Installation

NEMA WC 74/ICEA S-93-639 (2012) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

SOCIETY OF CABLE TELECOMMUNICATIONS ENGINEERS (SCTE)

ANSI/SCTE 77 (2013) Specification for Underground Enclosure Integrity

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-758 (2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 1751F-644 (2002) Underground Plant Construction

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60005 (Basic; Notice 2) Frames, Covers,
Gratings, Steps, Sump And Catch Basin,
Manhole

UNDERWRITERS LABORATORIES (UL)

UL 6 (2007; Reprint Sep 2019) UL Standard for
Safety Electrical Rigid Metal Conduit-Steel

UL 44 (2018; Reprint May 2021) UL Standard for
Safety Thermoset-Insulated Wires and Cables

UL 83 (2017; Reprint Mar 2020) UL Standard for
Safety Thermoplastic-Insulated Wires and
Cables

UL 94 (2013; Reprint May 2021) UL Standard for
Safety Tests for Flammability of Plastic
Materials for Parts in Devices and
Appliances

UL 467 (2013; Reprint Jun 2017) UL Standard for
Safety Grounding and Bonding Equipment

UL 486A-486B (2018; Reprint May 2021) UL Standard for
Safety Wire Connectors

UL 514B (2012; Reprint May 2020) Conduit, Tubing
and Cable Fittings

UL 651 (2011; Reprint Mar 2020) UL Standard for
Safety Schedule 40, 80, Type EB and A
Rigid PVC Conduit and Fittings

UL 854 (2020) Standard for Service-Entrance Cables

UL 1072 (2006; Reprint Apr 2020) Medium-Voltage
Power Cables

UL 1242 (2006; Reprint Aug 2020) Standard for
Electrical Intermediate Metal Conduit --
Steel

1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Std 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.

1.3 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

Precast Underground Structures; G

SD-03 Product Data

Medium Voltage Cable; G

Precast Concrete Structures; G

Sealing Material

Pulling-In Irons

Manhole Frames and Covers; G

Handhole Frames and Covers; G

Composite/Fiberglass Handholes; G

Cable Supports (racks, arms and insulators); G

SD-06 Test Reports

Field Acceptance Checks and Tests; G

1.4 QUALITY ASSURANCE

1.4.1 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

1.4.2 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. 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.

1.4.2.1 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.

1.4.2.2 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 Duct for Concrete Encasement

Provide Type EPC-40 per UL 651 and NEMA TC 2.

2.1.4 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.

2.1.5 Fittings

2.1.5.1 Metal Fittings

UL 514B.

2.1.5.2 PVC Conduit Fittings

UL 514B, UL 651.

2.1.5.3 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. All conductors must be copper.

2.2.2 Conductor Material

Unless specified or indicated otherwise or required by NFPA 70, wires in conduit, other than service entrance, must be 600-volt, Type THWN/THHN conforming to UL 83 or Type XHHW or RHW conforming to UL 44. Copper conductors must be annealed copper complying with ASTM B3 and ASTM B8.

2.2.3 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.

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 12 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 soft drawn copper cables complying with ASTM B3 and ASTM B8 for regular concentric and compressed stranding or ASTM B496 for compact stranding.

2.5.3 Insulation

Provide ethylene-propylene-rubber (EPR) insulation conforming to the requirements of ANSI/NEMA WC 74/ICEA S-93-639.

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 Jackets

Provide cables with a PVC jacket. Provide PVC jackets with a separator that prevents contact with underlying semiconducting insulating shield.

2.6 TELECOMMUNICATIONS CABLING

Provide telecommunications cabling in accordance with Section 33 82 00 TELECOMMUNICATIONS OUTSIDE PLANT (OSP).

2.7 PULL ROPE

Plastic or flat pull line (bull line) having a minimum tensile strength of 200 pounds.

2.8 GROUNDING AND BONDING

2.8.1 Driven Ground Rods

Provide solid copper 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.

2.8.2 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.

2.9 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.

2.10 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.

2.10.1 Cast-In-Place Concrete Structures

Concrete must conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.10.2 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.

2.10.2.1 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.

2.10.2.2 Design for Precast Structures

ACI 318M. In the absence of detailed on-site soil information, design for the following soil parameters/site conditions:

- a. Angle of Internal Friction (ϕ) = 30 degrees

- b. Unit Weight of Soil (Dry) = 110 pcf, (Saturated)
= 130 pcf
- c. Coefficient of Lateral Earth Pressure (K_a) = 0.33
- d. Ground Water Level = 3 feet below ground elevation
- e. Vertical design loads must include full dead, superimposed dead, and live loads including a 30 percent magnification factor for impact. Live loads must consider all types and magnitudes of vehicular (automotive, industrial, 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.

2.10.2.3 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.

2.10.2.4 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.

2.10.3 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.

2.10.4 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.

2.10.5 Composite/Fiberglass Handholes and Covers

ANSI/SCTE 77. Provide handholes and covers of polymer concrete, reinforced with heavy weave fiberglass with a design load (Tier rating) appropriate for or greater than the intended use. All covers are required to have the Tier level rating embossed on the surface which must not exceed the design load of the box.

2.11 CABLE SUPPORTS (RACKS, ARMS, AND INSULATORS)

Zinc coat the metal portion of racks and arms after fabrication.

2.11.1 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.

2.11.2 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.

2.11.3 Insulators

Insulators for metal rack arms must be dry-process glazed porcelain. Insulators are not required for nylon arms.

2.12 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.

2.12.1 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.

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 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.

3.4 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.

3.4.1 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.

3.4.2 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.

3.4.3 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.

3.4.4 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.

3.4.5 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.

3.5 UNDERGROUND CONDUIT AND DUCT SYSTEMS

3.5.1 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 below 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.

3.5.2 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.

3.5.3 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.

3.5.4 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.

3.5.5 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.

3.5.6 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.

3.5.7 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.

3.5.7.1 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.

3.5.8 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. Provide steel reinforcing in the concrete envelope as indicated. Provide color, type and depth of warning tape as specified in Section 31 00 00 EARTHWORK.

3.5.8.1 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.

3.5.8.2 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.

3.5.8.3 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.

3.5.8.4 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.

3.5.9 Duct Sealing

Seal all electrical penetrations for radon mitigation, maintaining integrity of the vapor barrier, and to prevent infiltration of air, insects, and vermin.

3.6 CABLE PULLING

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.

3.6.1 Cable Lubricants

Use lubricants that are specifically recommended by the cable manufacturer for assisting in pulling jacketed cables.

3.7 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.

3.7.1 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.

3.8 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.

3.9 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 GROUNDING SYSTEMS

NFPA 70 and IEEE C2, except provide grounding systems with a resistance to solid earth ground not exceeding 25 ohms.

3.10.1 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.

3.10.2 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.

3.10.3 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.

3.10.4 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.

3.10.5 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.

3.11 EXCAVATING, BACKFILLING, AND COMPACTING

Provide in accordance with NFPA 70 and Section 31 00 00 EARTHWORK.

3.11.1 Reconditioning of Surfaces

3.11.1.1 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.

3.11.1.2 Paving Repairs

Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, restore such surface treatment or pavement the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces.

3.12 CAST-IN-PLACE CONCRETE

Provide concrete in accordance with Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.12.1 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.

3.13 FIELD QUALITY CONTROL

3.13.1 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.

3.13.1.1 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.

3.13.1.2 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.

3.13.2 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 --

SECTION TABLE OF CONTENTS

DIVISION 33 - UTILITIES

SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

04/06

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 RELATED REQUIREMENTS
- 1.3 DEFINITIONS
 - 1.3.1 Campus Distributor (CD)
 - 1.3.2 Entrance Facility (EF) (Telecommunications)
 - 1.3.3 Distribution Room (ER) (Telecommunications)
 - 1.3.4 Building Distributor (BD)
 - 1.3.5 Pathway
- 1.4 SYSTEM DESCRIPTION
- 1.5 SUBMITTALS
- 1.6 QUALITY ASSURANCE
 - 1.6.1 Shop Drawings
 - 1.6.1.1 Telecommunications Outside Plant Shop Drawings
 - 1.6.1.2 Telecommunications Entrance Facility Drawings
 - 1.6.2 Telecommunications Qualifications
 - 1.6.2.1 Telecommunications Contractor Qualifications
 - 1.6.2.2 Key Personnel Qualifications
 - 1.6.2.3 Minimum Manufacturer's Qualifications
 - 1.6.3 Outside Plant Test Plan
 - 1.6.4 Standard Products
 - 1.6.4.1 Alternative Qualifications
 - 1.6.4.2 Material and Equipment Manufacturing Date
 - 1.6.5 Regulatory Requirements
 - 1.6.5.1 Independent Testing Organization Certificate
- 1.7 DELIVERY, STORAGE, AND HANDLING
- 1.8 MAINTENANCE
 - 1.8.1 Record Documentation
 - 1.8.2 Spare Parts
- 1.9 WARRANTY

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
- 2.2 TELECOMMUNICATIONS ENTRANCE FACILITY
 - 2.2.1 Building Protector Assemblies
 - 2.2.2 Protector Modules
 - 2.2.3 Fiber Optic Terminations
- 2.3 CLOSURES
 - 2.3.1 Copper Conductor Closures
 - 2.3.1.1 Underground Cable Closures
 - 2.3.2 Fiber Optic Closures
 - 2.3.2.1 In Vault or Maintenance Hole
- 2.4 PAD MOUNTED CROSS-CONNECT TERMINAL CABINETS
- 2.5 CABLE SPLICES, AND CONNECTORS

- 2.5.1 Copper Cable Splices
- 2.5.2 Copper Cable Splice Connector
- 2.5.3 Fiber Optic Cable Splices
- 2.5.4 Fiber Optic Splice Organizer
- 2.5.5 Shield Connectors
- 2.6 CONDUIT
- 2.7 PLASTIC INSULATING TAPE
- 2.8 WIRE AND CABLE
 - 2.8.1 Copper Conductor Cable
 - 2.8.1.1 Underground
 - 2.8.2 Fiber Optic Cable
 - 2.8.2.1 Strength Members
 - 2.8.2.2 Shielding or Other Metallic Covering
 - 2.8.2.3 Performance Requirements
 - 2.8.3 Grounding and Bonding Conductors
- 2.9 T-SPAN LINE TREATMENT REPEATERS
- 2.10 POLES AND HARDWARE
- 2.11 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS
 - 2.11.1 Stainless Steel
- 2.12 BURIED WARNING AND IDENTIFICATION TAPE
- 2.13 GROUNDING BRAID
- 2.14 MANUFACTURER'S NAMEPLATE
- 2.15 FIELD FABRICATED NAMEPLATES
- 2.16 TESTS, INSPECTIONS, AND VERIFICATIONS
 - 2.16.1 Factory Reel Test Data

PART 3 EXECUTION

- 3.1 INSTALLATION
 - 3.1.1 Contractor Damage
 - 3.1.2 Cable Inspection and Repair
 - 3.1.3 Direct Burial System
 - 3.1.3.1 Cable Placement
 - 3.1.3.2 Identification Slabs Markers
 - 3.1.3.3 Backfill for Rocky Soil
 - 3.1.4 Cable Protection
 - 3.1.4.1 Cable End Caps
 - 3.1.5 Underground Duct
 - 3.1.6 Reconditioning of Surfaces
 - 3.1.7 Penetrations
 - 3.1.8 Cable Pulling
 - 3.1.8.1 Cable Tensions
 - 3.1.8.2 Pulling Eyes
 - 3.1.8.3 Installation of Cables in Maintenance Hole, Handholes, and Vaults
 - 3.1.9 Cable Splicing
 - 3.1.9.1 Copper Conductor Splices
 - 3.1.9.2 Fiber Optic Splices
 - 3.1.10 Surge Protection
 - 3.1.11 Grounding
 - 3.1.11.1 Primary Bonding Busbar (PBB)
 - 3.1.11.2 Incoming Cable Shields
 - 3.1.11.3 Campus Distributor Grounding
 - 3.1.12 Cut-Over
- 3.2 LABELING
 - 3.2.1 Labels
 - 3.2.2 Cable Tag Installation
 - 3.2.3 Termination Hardware
- 3.3 FIELD APPLIED PAINTING

- 3.3.1 Cleaning
 - 3.3.2 Priming
 - 3.3.3 Finish Coat
 - 3.4 FIELD FABRICATED NAMEPLATE MOUNTING
 - 3.5 FIELD QUALITY CONTROL
 - 3.5.1 Pre-Installation Tests
 - 3.5.1.1 Cable Capacitance
 - 3.5.1.2 Loop Resistance
 - 3.5.1.3 Pre-Installation Test Results
 - 3.5.2 Acceptance Tests
 - 3.5.2.1 Copper Conductor Cable
 - 3.5.2.2 Fiber Optic Cable
 - 3.5.3 Soil Density Tests
- End of Section Table of Contents --

SECTION 33 82 00

TELECOMMUNICATIONS OUTSIDE PLANT (OSP)

04/06

PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-87-640	(2016) Optical Fiber Outside Plant Communications Cable; 4th Edition
ICEA S-98-688	(2012) Broadband Twisted Pair Telecommunication Cable, Aircore, Polyolefin Insulated, Copper Conductors Technical Requirements
ICEA S-99-689	(2012) Broadband Twisted Pair Telecommunication Cable Filled, Polyolefin Insulated, Copper Conductors Technical Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4)
National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE No.3 (2007) Commercial Blast Cleaning

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-455-78-B (2020c) FOTP-78 Optical Fibres - Part 1-40: Measurement Methods and Test Procedures - Attenuation

TIA-455-107 (1999a) FOTP-107 Determination of Component Reflectance or Link/System Return Loss using a Loss Test Set

TIA-492CAAA (1998; R 2002) Detail Specification for Class IVa Dispersion-Unshifted Single-Mode Optical Fibers

TIA-492E000 (1996; R 2002) Sectional Specification for Class IVd Nonzero-Dispersion Single-Mode Optical Fibers for the 1550 nm Window

TIA-526-7 (2015a) OFSTP-7 Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant

TIA-526-14 (2015c) OFSTP-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant

TIA-568.1-E (2020e) Commercial Building Telecommunications Cabling Standard

TIA-568.2-D (2018d) ADDENDUM 2 2020) Balanced Twisted-Pair Telecommunications Cabling and Components Standards

TIA-568.3-D (2016d ADDENDUM 1 2022e) Optical Fiber Cabling Components Standard

TIA-569 (2019e) ADDENDUM 1 2019) Commercial Building Standard for Telecommunications Pathways and Spaces

TIA-590 (1997a) Standard for Physical Location and Protection of Below Ground Fiber Optic Cable Plant

TIA-606 (2021d) Administration Standard for the Telecommunications Infrastructure

TIA-607	((2019d) ADDENDUM 1 2021) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
TIA-758	(2012b) Customer-Owned Outside Plant Telecommunications Infrastructure Standard
TIA/EIA-455	(1998b) Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fiber Optic Components
TIA/EIA-598	(2014D; Add 2 2018) Optical Fiber Cable Color Coding

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS 1755	Telecommunications Standards and Specifications for Materials, Equipment and Construction
RUS Bull 345-50	(1979) Trunk Carrier Systems (PE-60)
RUS Bull 345-65	(1985) Shield Bonding Connectors (PE-65)
RUS Bull 345-72	(1985) Filled Splice Closures (PE-74)
RUS Bull 345-83	(1979; Rev Oct 1982) Gas Tube Surge Arrestors (PE-80)
RUS Bull 1751F-630	(1996) Design of Aerial Plant
RUS Bull 1751F-643	(2002) Underground Plant Design
RUS Bull 1751F-815	(1979) Electrical Protection of Outside Plant
RUS Bull 1753F-201	(1997) Acceptance Tests of Telecommunications Plant (PC-4)
RUS Bull 1753F-401	(1995) Splicing Copper and Fiber Optic Cables (PC-2)

UNDERWRITERS LABORATORIES (UL)

UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 497	(2001; Reprint Jul 2013) Protectors for Paired Conductor Communication Circuits
UL 510	(2020) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape

1.2 RELATED REQUIREMENTS

Section 33 71 02, UNDERGROUND ELECTRICAL DISTRIBUTION apply to this

section with additions and modifications specified herein.

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in this specification must be as defined in TIA-568.0-D, TIA-568.1-D, TIA-568.2-D, TIA-568.3-D, TIA-568.4-D, TIA-569, TIA-606, and IEEE 100 and herein.

1.3.1 Campus Distributor (CD)

A distributor from which the campus backbone cabling emanates. (International expression for main cross-connect - (MC).)

1.3.2 Entrance Facility (EF) (Telecommunications)

An entrance to the building for both private and public network service cables (including antennae) including the entrance point at the building wall and continuing to the entrance room or space.

1.3.3 Distribution Room (ER) (Telecommunications)

A centralized space for telecommunications equipment that serves the occupants of a building. Equipment housed therein is considered distinct from a telecommunications room because of the nature of its complexity.

1.3.4 Building Distributor (BD)

A distributor in which the building backbone cables terminate and at which connections to the campus backbone cables may be made. (International expression for intermediate cross-connect - (IC).)

1.3.5 Pathway

A physical infrastructure utilized for the placement and routing of telecommunications cable.

1.4 SYSTEM DESCRIPTION

The telecommunications outside plant consists of cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, interconnecting hardware, terminating cables, lightning and surge protection modules at the entrance facility. The work consists of providing, testing and making operational cabling, interconnecting hardware and lightning and surge protection necessary to form a complete outside plant telecommunications system for continuous use.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" 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

Telecommunications Outside Plant; G

Telecommunications Entrance Facility Drawings; G

In addition to Section 01 33 00 SUBMITTAL PROCEDURES, provide shop drawings in accordance with paragraph SHOP DRAWINGS.

SD-03 Product Data

Wire and cable; G

Cable splices, and connectors; G

Closures; G

Building protector assemblies; G

Protector modules; G

Cross-connect terminal cabinets; G

Spare Parts; G

Submittals shall include the manufacturer's name, trade name, place of manufacture, and catalog model or number. Submittals shall also include applicable federal, military, industry, and technical society publication references. Should manufacturer's data require supplemental information for clarification, the supplemental information shall be submitted as specified in paragraph REGULATORY REQUIREMENTS and as required for certificates in Section 01 33 00 SUBMITTAL PROCEDURES.

SD-06 Test Reports

Pre-installation tests; G

Acceptance tests; G

Outside Plant Test Plan; G

SD-07 Certificates

Telecommunications Contractor Qualifications; G

Key Personnel Qualifications; G

Minimum Manufacturer's Qualifications; G

SD-08 Manufacturer's Instructions

Building protector assembly installation; G

Cable tensions; G

Fiber Optic Splices; G

Submit instructions prior to installation.

SD-09 Manufacturer's Field Reports

Factory Reel Test Data; G

SD-10 Operation and Maintenance Data

Telecommunications outside plant (OSP), Data Package 5; G

Commercial off-the-shelf manuals shall be provided for operation, installation, configuration, and maintenance of products provided as a part of the telecommunications outside plant (OSP). Submit operations and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein not later than 2 months prior to the date of beneficial occupancy. In addition to requirements of Data package 5, include the requirements of paragraphs TELECOMMUNICATIONS OUTSIDE PLANT SHOP DRAWINGS and TELECOMMUNICATIONS ENTRANCE FACILITY DRAWINGS.

SD-11 Closeout Submittals

Record Documentation; G

In addition to other requirements, provide in accordance with paragraph RECORD DOCUMENTATION.

1.6 QUALITY ASSURANCE

1.6.1 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.6.1.1 Telecommunications Outside Plant Shop Drawings

Provide Outside Plant Design in accordance with TIA-758, RUS Bull 1751F-630 for aerial system design, and RUS Bull 1751F-643 for underground system design. Provide T0 shop drawings that show the physical and logical connections from the perspective of an entire campus, such as actual building locations, exterior pathways and campus backbone cabling on plan view drawings, major system nodes, and related connections on the logical system drawings in accordance with TIA-606. Drawings shall include wiring and schematic diagrams for fiber optic and copper cabling and splices, copper conductor gauge and pair count, fiber pair count and type, pathway duct and innerduct arrangement, associated construction materials, and any details required to demonstrate that cable system has been coordinated and will properly support the switching and transmission system identified in specification and drawings. Provide Registered Communications Distribution Designer (RCDD) approved drawings of the telecommunications outside plant. Update existing telecommunication Outside Plant T0 drawings to include information modified, deleted or added as a result of this installation in accordance with TIA-606. The telecommunications outside plant (OSP) shop drawings must be included in the operation and

maintenance manuals.

1.6.1.2 Telecommunications Entrance Facility Drawings

Provide T3 drawings for EF Telecommunications in accordance with TIA-606 that include telecommunications entrance facility plan views, pathway layout (cable tray, racks, ladder-racks, etc.), mechanical/electrical layout, and cabinet, rack, backboard and wall elevations. Drawings shall show layout of applicable equipment including incoming cable stub or connector blocks, building protector assembly, outgoing cable connector blocks, patch panels and equipment spaces and cabinet/racks. Drawings shall include a complete list of equipment and material, equipment rack details, proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation. Drawings may also be an enlargement of a congested area of T1 or T2 drawings. Provide T3 drawings for EF Telecommunications as specified in the paragraph TELECOMMUNICATIONS SPACE DRAWINGS of Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS. The telecommunications entrance facility shop drawings shall be included in the operation and maintenance manuals.

1.6.2 Telecommunications Qualifications

Work under this section shall be performed by and the equipment shall be provided by the approved telecommunications contractor and key personnel. Qualifications shall be provided for: the telecommunications system contractor, the telecommunications system installer, the supervisor (if different from the installer), and the cable splicing and terminating personnel. A minimum of 30 days prior to installation, submit documentation of the experience of the telecommunications contractor and of the key personnel.

1.6.2.1 Telecommunications Contractor Qualifications

The telecommunications contractor shall be a firm which is regularly and professionally engaged in the business of the applications, installation, and testing of the specified telecommunications systems and equipment. The telecommunications contractor shall demonstrate experience in providing successful telecommunications systems that include outside plant and broadband cabling within the past 3 years. Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for the telecommunications contractor. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems in accordance with TIA-758 within the past 3 years.

1.6.2.2 Key Personnel Qualifications

Provide key personnel who are regularly and professionally engaged in the business of the application, installation and testing of the specified telecommunications systems and equipment. There may be one key person or more key persons proposed for this solicitation depending upon how many of the key roles each has successfully provided. Each of the key personnel shall demonstrate experience in providing successful telecommunications systems within the past 3 years.

Cable splicing and terminating personnel assigned to the installation of this system or any of its components shall have training in the proper techniques and have a minimum of 3 years experience in splicing and

terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

Supervisors and installers assigned to the installation of this system or any of its components shall have factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.

Submit documentation for a minimum of three and a maximum of five successful telecommunication system installations for each of the key personnel. Documentation for each key person shall include at least two successful system installations provided that are equivalent in system size and in construction complexity to the telecommunications system proposed for this solicitation. Include specific experience in installing and testing telecommunications outside plant systems, including broadband cabling, and provide the names and locations of at least two project installations successfully completed using optical fiber and copper telecommunications cabling systems. All of the existing telecommunications system installations offered by the key persons as successful experience shall have been in successful full-time service for at least 18 months prior to the issuance date for this solicitation. Provide the name and role of the key person, the title, location, and completed installation date of the referenced project, the referenced project owner point of contact information including name, organization, title, and telephone number, and generally, the referenced project description including system size and construction complexity.

Indicate that all key persons are currently employed by the telecommunications contractor, or have a commitment to the telecommunications contractor to work on this project. All key persons shall be employed by the telecommunications contractor at the date of issuance of this solicitation, or if not, have a commitment to the telecommunications contractor to work on this project by the date that the bid was due to the Contracting Officer.

Note that only the key personnel approved by the Contracting Officer in the successful proposal shall do work on this solicitation's telecommunications system. Key personnel shall function in the same roles in this contract, as they functioned in the offered successful experience. Any substitutions for the telecommunications contractor's key personnel requires approval from The Contracting Officer.

1.6.2.3 Minimum Manufacturer's Qualifications

Cabling, equipment and hardware manufacturers shall have a minimum of 3 years experience in the manufacturing, assembly, and factory testing of components which comply with, TIA-568.1-E, TIA-568.2-D, and TIA-568.3-D. In addition, cabling manufacturers shall have a minimum of 3 years experience in the manufacturing and factory testing of cabling which comply with ICEA S-87-640, ICEA S-98-688, and ICEA S-99-689.

1.6.3 Outside Plant Test Plan

Prepare and provide a complete and detailed test plan for field tests of the outside plant including a complete list of test equipment for the copper conductor and optical fiber cables, components, and accessories for approval by the Contracting Officer. Include a cut-over plan with procedures and schedules for relocation of facility station numbers

without interrupting service to any active location. Submit the plan at least 30 days prior to tests for Contracting Officer approval. Provide outside plant testing and performance measurement criteria in accordance with TIA-568.1-E and RUS Bull 1753F-201. Include procedures for certification, validation, and testing that includes fiber optic link performance criteria.

1.6.4 Standard Products

Provide materials and equipment that are standard products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and shall be the manufacturer's latest standard design that has been in satisfactory commercial or industrial use for at least 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.4.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is provided.

1.6.4.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6.5 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of NFPA 70 unless more stringent requirements are specified or indicated.

1.6.5.1 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the Contracting Officer. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.7 DELIVERY, STORAGE, AND HANDLING

Ship cable on reels in 1000 feet length with a minimum overage of 10

percent. Radius of the reel drum shall not be smaller than the minimum bend radius of the cable. Wind cable on the reel so that unwinding can be done without kinking the cable. Two meters of cable at both ends of the cable shall be accessible for testing. Attach permanent label on each reel showing length, cable identification number, cable size, cable type, and date of manufacture. Provide water resistant label and the indelible writing on the labels. Apply end seals to each end of the cables to prevent moisture from entering the cable. Reels with cable shall be suitable for outside storage conditions when temperature ranges from minus 40 degrees C to plus 65 degrees C, with relative humidity from 0 to 100 percent. Equipment, other than cable, delivered and placed in storage shall be stored with protection from weather, humidity and temperature variation, dirt and dust, or other contaminants in accordance with manufacturer's requirements.

1.8 MAINTENANCE

1.8.1 Record Documentation

Provide the activity responsible for telecommunications system maintenance and administration a single complete and accurate set of record documentation for the entire telecommunications system with respect to this project.

Provide T5 drawings including documentation on cables and termination hardware in accordance with TIA-606. T5 drawings shall include schedules to show information for cut-overs and cable plant management, patch panel layouts, cross-connect information and connecting terminal layout as a minimum. T5 drawings shall be provided on electronic media using Windows based computer cable management software. A licensed copy of the cable management software including documentation, shall be provided. Update existing record documentation to reflect campus distribution T0 drawings and T3 drawing schedule information modified, deleted or added as a result of this installation. Provide the following T5 drawing documentation as a minimum:

- a. Cables - A record of installed cable must be provided in accordance with TIA-606. The cable records must include the required data fields for each cable and complete end-to-end circuit report for each complete circuit from the assigned outlet to the entry facility in accordance with TIA-606. Include manufacture date of cable with submittal.
- b. Termination Hardware - Provide a record of installed patch panels, cross-connect points, campus distributor and terminating block arrangements and type in accordance with TIA-606. Documentation shall include the required data fields in accordance with TIA-606.

Provide record documentation as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

1.8.2 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. Spare parts shall be provided no later than the start of field testing.

1.9 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Products supplied shall be specifically designed and manufactured for use with outside plant telecommunications systems.

2.2 TELECOMMUNICATIONS ENTRANCE FACILITY

2.2.1 Building Protector Assemblies

Provide self-contained 5 pin unit supplied with a field cable stub factory connected to protector socket blocks to terminate and accept protector modules for 200 pairs of outside cable. Building protector assembly shall have interconnecting hardware for connection to interior cabling at full capacity. Provide manufacturers instructions for building protector assembly installation. Provide copper cable interconnecting hardware as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.2.2 Protector Modules

Provide in accordance with UL 497 solid state type 5 pin rated for the application. Provide gas tube protection modules in accordance with RUS Bull 345-83 and shall be heavy duty, A>10kA, B>400, C>65A where A is the maximum single impulse discharge current, B is the impulse life and C is the AC discharge current in accordance with ANSI C62.61. The gas modules shall shunt high voltage to ground, fail short, and be equipped with an external spark gap and heat coils in accordance with UL 497. Provide the number of surge protection modules equal to the number of pairs of exterior cable of the building protector assembly.

2.2.3 Fiber Optic Terminations

Provide unkeyed duplex-LC OS2 single-mode fiber optic cable terminations in fiber optic distribution panels using 12-strand modules in 1U 6-module rack-mounted enclosures. All terminations must be fusion-spliced to pre-assembled pig-tails.

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Underground Cable Closures

- a. In vault or manhole: Provide underground closure suitable to house a butt splice in a protective housing into which can be poured an encapsulating compound. Closure shall be of suitable thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or maintenance hole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure. Provide filled splice cases in accordance with

RUS Bull 345-72.

2.3.2 Fiber Optic Closures

2.3.2.1 In Vault or Maintenance Hole

Provide underground closure suitable to house splice organizer in a protective housing into which can be poured an encapsulating compound. Closure shall be of thermoplastic, thermoset, or stainless steel material supplying structural strength necessary to pass the mechanical and electrical requirements in a vault or manhole environment. Encapsulating compound shall be reenterable and shall not alter the chemical stability of the closure.

2.4 PAD MOUNTED CROSS-CONNECT TERMINAL CABINETS

Provide in accordance with RUS 1755.910 and the following:

- a. Constructed of 14 gauge stainless steel with NEMA 4X rating.
- b. Equipped with a double set of hinged doors with closed-cell foam weatherstripping. Doors shall be locked and contain a marker as indicated.
- c. Equipped with spool spindle bracket, mounting frames, binding post log, jumpering instruction label, and load coil mounting provisions.
- d. Complete with cross connect modules to terminate number of pairs as indicated.
- e. Sized as indicated.

2.5 CABLE SPLICES, AND CONNECTORS

2.5.1 Copper Cable Splices

Provide multipair, foldback in-line butt splices of a moisture resistant, 25-pair insulation displacement connector held rigidly in place to assure maximum continuity in accordance with RUS Bull 1753F-401. Cables greater than 25 pairs shall be spliced using multipair splicing connectors, which accommodate 25 pairs of conductors at a time. Provide correct connector size to accommodate the cable gauge of the supplied cable.

2.5.2 Copper Cable Splice Connector

Provide splice connectors with a polycarbonate body and cap and a tin-plated brass contact element. Connector shall accommodate 22 to 26 AWG solid wire with a maximum insulation diameter of 0.065 inch. Fill connector with sealant grease to make a moisture resistant connection, in accordance with RUS Bull 1753F-401.

2.5.3 Fiber Optic Cable Splices

Provide fiber optic cable splices and splicing materials for fusion methods at locations shown on the construction drawings. The splice insertion loss shall be 0.3 dB maximum when measured in accordance with TIA-455-78-B using an Optical Time Domain Reflectometer (OTDR). Splices shall be designed for a return loss of 40.0 db max for single mode fiber when tested in accordance with TIA-455-107. Physically protect each fiber

optic splice by a splice kit specially designed for the splice.

2.5.4 Fiber Optic Splice Organizer

Provide splice organizer suitable for housing fiber optic splices in a neat and orderly fashion. Splice organizer shall allow for a minimum of 3 feet of fiber for each fiber within the cable to be neatly stored without kinks or twists. Splice organizer shall accommodate individual strain relief for each splice and allow for future maintenance or modification, without damage to the cable or splices. Provide splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors in a splice organizer kit.

2.5.5 Shield Connectors

Provide connectors with a stable, low-impedance electrical connection between the cable shield and the bonding conductor in accordance with RUS Bull 345-65.

2.6 CONDUIT

Provide conduit as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

2.7 PLASTIC INSULATING TAPE

UL 510.

2.8 WIRE AND CABLE

2.8.1 Copper Conductor Cable

Solid copper conductors, covered with an extruded solid insulating compound. Insulated conductors shall be twisted into pairs which are then stranded or oscillated to form a cylindrical core. For special high frequency applications, the cable core shall be separated into compartments. Cable shall be completed by the application of a suitable core wrapping material, a corrugated copper or plastic coated aluminum shield, and an overall extruded jacket. Telecommunications contractor shall verify distances between splice points prior to ordering cable in specific cut lengths. Gauge of conductor shall determine the range of numbers of pairs specified; 19 gauge (6 to 400 pairs), 22 gauge (6 to 1200 pairs), 24 gauge (6 to 2100 pairs), and 26 gauge (6 to 3000 pairs). Copper conductor shall conform to the following:

2.8.1.1 Underground

Provide filled cable meeting the requirements of ICEA S-99-689 and RUS 1755.890.

2.8.2 Fiber Optic Cable

Provide single-mode, 8/125-um, 0.10 aperture 1310 nm fiber optic cable in accordance with TIA-492CAAA; single-mode, 8/125-um, 0.10 aperture 1550 nm fiber optic cable in accordance with TIA-492E000, including any special requirements made necessary by a specialized design. Provide 144 strand OS2 optical fiber or as indicated on drawings. Fiber optic cable shall be specifically designed for outside use with loose buffer construction. Provide fiber optic color code in accordance with TIA/EIA-598

2.8.2.1 Strength Members

Provide central, non-metallic strength members with sufficient tensile strength for installation and residual rated loads to meet the applicable performance requirements in accordance with ICEA S-87-640. The strength member is included to serve as a cable core foundation to reduce strain on the fibers, and shall not serve as a pulling strength member.

2.8.2.2 Shielding or Other Metallic Covering

Provide copper, copper alloy or copper and steel laminate, stainless steel, coated stainless steel or bare low carbon steel, dual tape covering or shield in accordance with ICEA S-87-640.

2.8.2.3 Performance Requirements

Provide fiber optic cable with optical and mechanical performance requirements in accordance with ICEA S-87-640.

2.8.3 Grounding and Bonding Conductors

Provide grounding and bonding conductors in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Solid bare copper wire meeting the requirements of ASTM B1 for sizes No. 8 AWG and smaller and stranded bare copper wire meeting the requirements of ASTM B8, for sizes No. 6 AWG and larger. Insulated conductors shall have 600-volt, Type TW insulation meeting the requirements of UL 83.

2.9 T-SPAN LINE TREATMENT REPEATERS

Provide as indicated. Repeaters shall be pedestal mounted with non-pressurized housings, sized as indicated and shall meet the requirements of RUS Bull 345-50.

2.10 POLES AND HARDWARE

Provide poles and hardware as specified in these specifications.

2.11 CABLE TAGS IN MANHOLES, HANDHOLES, AND VAULTS

Provide tags for each telecommunications cable or wire located in manholes, handholes, and vaults. Cable tags shall be stainless steel and labeled as indicated in accordance with TIA-606. Handwritten labeling is unacceptable.

2.11.1 Stainless Steel

Provide stainless steel, cable tags 1 5/8 inches in diameter 1/16 inch thick minimum, and circular in shape. Tags shall be die stamped with numbers, letters, and symbols not less than 0.25 inch high and approximately 0.015 inch deep in normal block style.

2.12 BURIED WARNING AND IDENTIFICATION TAPE

Provide fiber optic media marking and protection in accordance with TIA-590. Provide color, type and depth of tape as specified in paragraph BURIED WARNING AND IDENTIFICATION TAPE in Section 31 00 00, EARTHWORK.

2.13 GROUNDING BRAID

Provide grounding braid that provides low electrical impedance connections for dependable shield bonding in accordance with RUS 1755.200. Braid shall be made from flat tin-plated copper.

2.14 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.

2.15 FIELD FABRICATED NAMEPLATES

Provide laminated plastic nameplates in accordance with ASTM D709 for each patch panel, protector assembly, rack, cabinet and other equipment or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.16 TESTS, INSPECTIONS, AND VERIFICATIONS

2.16.1 Factory Reel Test Data

Test 100 percent OTDR test of FO media at the factory in accordance with TIA-568.1-E and TIA-568.3-D. Use TIA-526-7 for single mode fiber and TIA-526-14 Method B for multi mode fiber measurements. Calibrate OTDR to show anomalies of 0.2 dB minimum. Enhanced performance filled OSP copper cables, referred to as Broadband Outside Plant (BBOSP), shall meet the requirements of ICEA S-99-689. Enhanced performance air core OSP copper cables shall meet the requirements of ICEA S-98-688. Submit test reports, including manufacture date for each cable reel and receive approval before delivery of cable to the project site.

PART 3 EXECUTION

3.1 INSTALLATION

Install all system components and appurtenances in accordance with manufacturer's instructions IEEE C2, NFPA 70, and as indicated. Provide all necessary interconnections, services, and adjustments required for a complete and operable telecommunications system.

3.1.1 Contractor Damage

Promptly repair indicated utility lines or systems damaged during site preparation and construction. Damages to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the Contract Clauses. When Contractor is advised in writing of the location of a nonindicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In every event, immediately notify the Contracting Officer of damage.

3.1.2 Cable Inspection and Repair

Handle cable and wire provided in the construction of this project with care. Inspect cable reels for cuts, nicks or other damage. Damaged cable shall be replaced or repaired to the satisfaction of the Contracting Officer. Reel wraps shall remain intact on the reel until the cable is ready for placement.

3.1.3 Direct Burial System

3.1.3.1 Cable Placement

- a. Separate cables crossing other cables or metal piping from the other cables or pipe by not less than 12 inches of well tamped earth. Do not install circuits for communications under or above traffic signal loops.
- b. Cables shall be in one piece without splices between connections except where the distance exceeds the lengths in which the cable is furnished.
- c. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.
- d. Leave a horizontal slack of approximately 3 feet in the ground on each end of cable runs, on each side of connection boxes, and at points where connections are brought aboveground. Where cable is brought aboveground, leave additional slack to make necessary connections.

3.1.3.2 Identification Slabs Markers

Provide a marker at each change of direction of the cable, over the ends of ducts or conduits which are installed under paved areas and roadways and over each splice. Identification markers shall be of concrete, approximately 20 inches square by 6 inches thick.

3.1.3.3 Backfill for Rocky Soil

When placing cable in a trench in rocky soil, the cable shall be cushioned by a fill of sand or selected soil at least 2 inches thick on the floor of the trench before placing the cable or wire. The backfill for at least 4 inches above the wire or cable shall be free from stones, rocks, or other hard or sharp materials which might damage the cable or wire. If the buried cable is placed less than 24 inches in depth, a protective cover of concrete shall be used.

3.1.4 Cable Protection

Provide direct burial cable protection in accordance with NFPA 70 and as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION. Galvanized conduits which penetrate concrete (slabs, pavement, and walls) shall be PVC coated and shall extend from the first coupling or fitting outside either side of the concrete minimum of 6 inches per 12 inches burial depth beyond the edge of the surface where cable protection is required; all conduits shall be sealed on each end. Where additional protection is required, cable may be placed in galvanized iron pipe (GIP) sized on a maximum fill of 40 percent of cross-sectional area, or in concrete encased 4 inches PVC pipe. Conduit may be installed by jacking

or trenching. Trenches shall be backfilled with earth and mechanically tamped at 6 inches lift so that the earth is restored to the same density, grade and vegetation as adjacent undisturbed material.

3.1.4.1 Cable End Caps

Cable ends shall be sealed at all times with coated heat shrinkable end caps. Cables ends shall be sealed when the cable is delivered to the job site, while the cable is stored and during installation of the cable. The caps shall 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.

3.1.5 Underground Duct

Provide underground duct and connections to existing manholes, handholes, concrete pads, and existing ducts as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION with any additional requirements as specified herein.

3.1.6 Reconditioning of Surfaces

Provide reconditioning of surfaces as specified in Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION.

3.1.7 Penetrations

Caulk and seal cable access penetrations in walls, ceilings and other parts of the building. Seal openings around electrical penetrations through fire resistance-rated wall, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.8 Cable Pulling

Test duct lines with a mandrel and swab out to remove foreign material before the pulling of cables. Avoid damage to cables in setting up pulling apparatus or in placing tools or hardware. Do not step on cables when entering or leaving the manhole. Do not place cables in ducts other than those shown without prior written approval of the Contracting Officer. Roll cable reels in the direction indicated by the arrows painted on the reel flanges. Set up cable reels on the same side of the manhole as the conduit section in which the cable is to be placed. Level the reel and bring into proper alignment with the conduit section so that the cable pays off from the top of the reel in a long smooth bend into the duct without twisting. Under no circumstances shall the cable be paid off from the bottom of a reel. Check the equipment set up prior to beginning the cable pulling to avoid an interruption once pulling has started. Use a cable feeder guide of suitable dimensions between cable reel and face of duct to protect cable and guide cable into the duct as it is paid off the reel. As cable is paid off the reel, lubricate and inspect cable for sheath defects. When defects are noticed, stop pulling operations and notify the Contracting Officer to determine required corrective action. Cable pulling shall also be stopped when reel binds or does not pay off freely. Rectify cause of binding before resuming pulling operations. Provide cable lubricants recommended by the cable manufacturer. Avoid bends in cables of small radii and twists that might cause damage. Do not bend cable and wire in a radius less than 10 times the outside diameter of the cable or wire.

3.1.8.1 Cable Tensions

Obtain from the cable manufacturer and provide to the Contracting Officer, the maximum allowable pulling tension. This tension shall not be exceeded.

3.1.8.2 Pulling Eyes

Equip cables 1.25 inches in diameter and larger with cable manufacturer's factory installed pulling-in eyes. Provide cables with diameter smaller than 1.25 inches with heat shrinkable type end caps or seals on cable ends when using cable pulling grips. Rings to prevent grip from slipping shall not be beaten into the cable sheath. Use a swivel of 3/4 inch links between pulling-in eyes or grips and pulling strand.

3.1.8.3 Installation of Cables in Maintenance Hole, Handholes, and Vaults

Do not install cables utilizing the shortest route, but route along those walls providing the longest route and the maximum spare cable lengths. Form cables to closely parallel walls, not to interfere with duct entrances, and support cables on brackets and cable insulators at a maximum of 4 feet. In existing manholes, handholes, and vaults where new ducts are to be terminated, or where new cables are to be installed, modify the existing installation of cables, cable supports, and grounding as required with cables arranged and supported as specified for new cables. Identify each cable with corrosion-resistant embossed metal tags.

3.1.9 Cable Splicing

3.1.9.1 Copper Conductor Splices

Perform splicing in accordance with requirements of RUS Bull 1753F-401 except that direct buried splices and twisted and soldered splices are not allowed. Exception does not apply for pairs assigned for carrier application.

3.1.9.2 Fiber Optic Splices

Fiber optic splicing shall be in accordance with manufacturer's recommendation and shall exhibit an insertion loss not greater than 0.2 dB for fusion splices.

3.1.10 Surge Protection

All cables and conductors, except fiber optic cable, which serve as communication lines through off-premise lines, shall have surge protection installed at each end which meet the requirements of RUS Bull 1751F-815.

3.1.11 Grounding

Provide grounding and bonding in accordance with RUS 1755.200, TIA-607, IEEE C2, and NFPA 70. Ground exposed noncurrent carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals.

3.1.11.1 Primary Bonding Busbar (PBB)

The PBB is the hub of the basic telecommunications grounding system providing a common point of connection for ground from outside cable, CD, and equipment. Establish a PBB for connection point for cable stub

shields to connector blocks and CD protector assemblies as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

3.1.11.2 Incoming Cable Shields

Shields shall not be bonded across the splice to the cable stubs. Ground shields of incoming cables in the EF Telecommunications to the TMGB.

3.1.11.3 Campus Distributor Grounding

- a. Protection assemblies: Mount CD protector assemblies directly on the telecommunications backboard. Connect assemblies mounted on each vertical frame with No. 6 AWG copper conductor to provide a low resistance path to PBB.
- b. PBB connection: Connect PBB to SBB with copper conductor with a total resistance of less than 0.01 ohms.

3.1.12 Cut-Over

All necessary transfers and cut-overs, shall be accomplished by the telecommunications contractor.

3.2 LABELING

3.2.1 Labels

Provide labeling for new cabling and termination hardware located within the facility in accordance with TIA-606. Handwritten labeling is unacceptable. Stenciled lettering for cable and termination hardware must be provided using laser printer.

3.2.2 Cable Tag Installation

Install cable tags for each telecommunications cable or wire located in manholes, handholes, and vaults including each splice. Tag only new wire and cable provided by this contract. Tag new wire and cable provided under this contract and existing wire and cable which are indicated to have splices and terminations provided by this contract. The labeling of telecommunications cable tag identifiers shall be in accordance with TIA-606. Tag legend shall be as indicated. Do not provide handwritten letters. Install cable tags so that they are clearly visible without disturbing any cabling or wiring in the manholes, handholes, and vaults.

3.2.3 Termination Hardware

Label patch panels, distribution panels, connector blocks and protection modules using color coded labels with identifiers in accordance with TIA-606.

3.3 FIELD APPLIED PAINTING

Provide ferrous metallic enclosure finishes in accordance with the following procedures. Ensure that surfaces are dry and clean when the coating is applied. Coat joints and crevices. Prior to assembly, paint surfaces which will be concealed or inaccessible after assembly. Apply primer and finish coat in accordance with the manufacturer's recommendations.

3.3.1 Cleaning

Clean surfaces in accordance with SSPC SP 6/NACE No.3.

3.3.2 Priming

Prime with a two component polyamide epoxy primer which has a bisphenol-A base, a minimum of 60 percent solids by volume, and an ability to build up a minimum dry film thickness on a vertical surface of 5.0 mils. Apply in two coats to a total dry film thickness of 5 to 8 mils.

3.3.3 Finish Coat

Finish with a two component urethane consisting of saturated polyester polyol resin mixed with aliphatic isocyanate which has a minimum of 50 percent solids by volume. Apply to a minimum dry film thickness of 2 to 3 mils. Color shall be the manufacturer's standard.

3.4 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.5 FIELD QUALITY CONTROL

Provide the Contracting Officer 10 working days notice prior to each test. Provide labor, equipment, and incidentals required for testing. Correct defective material and workmanship disclosed as the results of the tests. Furnish a signed copy of the test results to the Contracting Officer within 3 working days after the tests for each segment of construction are completed. Perform testing as construction progresses and do not wait until all construction is complete before starting field tests.

3.5.1 Pre-Installation Tests

Perform the following tests on cable at the job site before it is removed from the cable reel. For cables with factory installed pulling eyes, these tests shall be performed at the factory and certified test results shall accompany the cable.

3.5.1.1 Cable Capacitance

Perform capacitance tests on at least 10 percent of the pairs within a cable to determine if cable capacitance is within the limits specified.

3.5.1.2 Loop Resistance

Perform DC-loop resistance on at least 10 percent of the pairs within a cable to determine if DC-loop resistance is within the manufacturer's calculated resistance.

3.5.1.3 Pre-Installation Test Results

Provide results of pre-installation tests to the Contracting Officer at least 5 working days before installation is to start. Results shall indicate reel number of the cable, manufacturer, size of cable, pairs tested, and recorded readings. When pre-installation tests indicate that

cable does not meet specifications, remove cable from the job site.

3.5.2 Acceptance Tests

Perform acceptance testing in accordance with RUS Bull 1753F-201 and as further specified in this section. Provide personnel, equipment, instrumentation, and supplies necessary to perform required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test unless specified otherwise. Testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. Test plans shall define the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested. Provide test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

3.5.2.1 Copper Conductor Cable

Perform the following acceptance tests in accordance with TIA-758:

- a. Wire map (pin to pin continuity)
- b. Continuity to remote end
- c. Crossed pairs
- d. Reversed pairs
- e. Split pairs
- f. Shorts between two or more conductors

3.5.2.2 Fiber Optic Cable

Test fiber optic cable in accordance with TIA/EIA-455 and as further specified in this section. Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. In addition, a Bandwidth Test shall be performed on all multimode optical fibers. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable assembly.

- a. OTDR Test: The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings or improper splices for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 66 feet minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. Conduct OTDR test and provide calculation or interpretation of results in accordance with TIA-526-7 for single-mode fiber. Splice losses shall

not exceed 0.3 db.

- b. Attenuation Test: End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 850, 1300, 1310, and 1550 nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met in accordance with TIA-526-7 for single-mode fiber optic cables. The measurement method shall be in accordance with TIA-455-78-B. Attenuation losses shall not exceed 0.5 db/km at 1310 nm and 1550 nm for single-mode fiber.

3.5.3 Soil Density Tests

- a. Determine soil-density relationships for compaction of backfill material in accordance with ASTM D1557, Method D.
- b. Determine soil-density relationships as specified for soil tests in Section 31 00 00 EARTHWORK.

-- End of Section --

This page was intentionally left blank for duplex printing.

This page was intentionally left blank for duplex printing.

BUILDING STRONG!



**US Army Corps
of Engineers** ®

Omaha District